AD-A144 768 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS COLUMBIA LAKE DAM (CT..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV SEP 78 1/2

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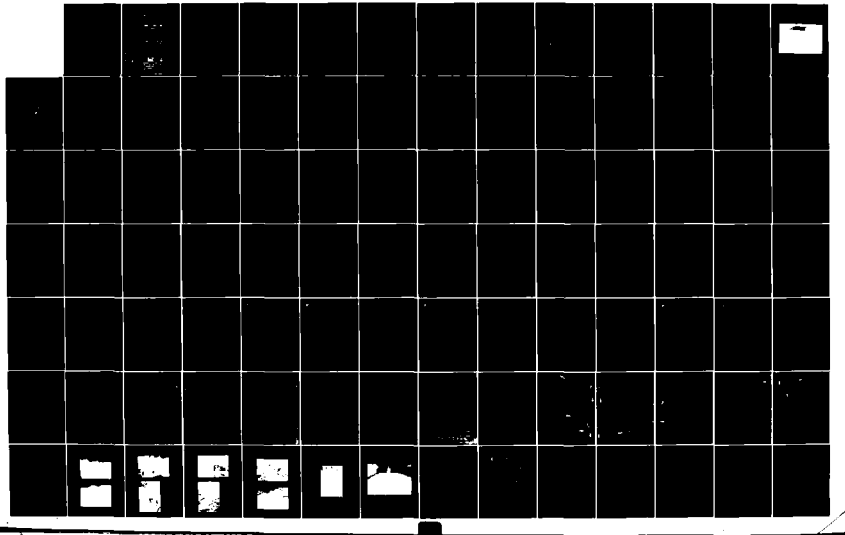

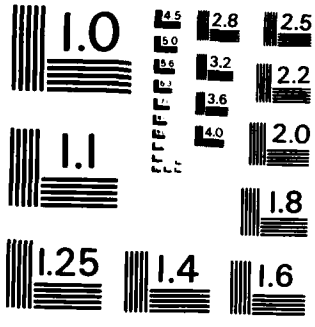

THAMES RIVER BASIN
COLUMBIA, CONNECTICUT

COLUMBIA LAKE DAM
CT 00520

PHASE 1 INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

SEPTEMBER 1978

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Thames River Basin
Columbia, Connecticut

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Columbia Lake Dam is an earth dam which is approximately 295.0 ft. long (including spillway) and has a maximum height of 28.0 ft. The dam is considered to be in poor condition. A spillway design test flood outflow of 1418 cfs (½ the PMF) will overtop the dam by approximately 0.93 ft.

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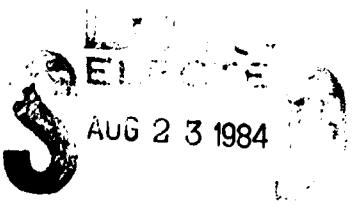
COLUMBIA LAKE DAM

CT 00520

THAMES RIVER BASIN

COLUMBIA, CONNECTICUT

PHASE 1 INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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NATIONAL DAM INSPECTION PROGRAM

PHASE 1 INSPECTION REPORT

Identification No.:	CT 00520
Name of Dam:	Columbia Lake Dam
Town:	Columbia
County and State:	Tolland County, Connecticut
Stream:	Unnamed Stream
Date of Inspection:	18 May, 1978

BRIEF ASSESSMENT

Columbia Lake Dam is an earth dam which was constructed in 1865. The dam has a maximum height of 28.0 ft. and is approximately 295.0 ft. long (including spillway). The embankment slopes are approximately 2.5 H : 1.0 V. The crest and downstream slope are grassed and the upstream face is riprapped above water level and to a depth of 3.0 ft. below water surface. The spillway is located on the extreme left abutment of the embankment and is a curved converging type contained between vertical rubble masonry walls. It is 26.0 ft. wide by 260.0 ft. long with a rubble stone bed that was filled with dumped concrete. The spillway flows discharge into a narrow natural stream bed leading to a 6.0 ft. x 4.5 ft. concrete box culvert beneath

Route 87 immediately downstream from the dam. There are no plans, specifications or computations available from the Owner, County or State offices regarding the design, construction or repairs of this dam.

Due to its age, Columbia Lake Dam was neither designed nor constructed by approved state of the art methods. Based upon the visual inspection at the site, the lack of engineering data available, and no operational or maintenance evidence, there are areas of concern which must be corrected to assure the long term performance of this dam. Therefore, based on existing information, this dam is considered to be in poor condition.

There are several visible signs of distress which indicate a potential hazard at this site: undermining and erosion beneath the spillway bed, deterioration of the outlet gate to the point where its operation is difficult and unreliable, erosion holes adjacent to the operating mechanism which may indicate leakage or seepage along the outlet conduit, emerging seepage along the downstream toe of the dam, dislodged stonework and obstructed downstream spillway channel and a general lack of proper, regular maintenance.

Hydraulic analyses indicate that the existing spillway can discharge a maximum flow of 624.0 cfs at Elev. 502.0 (top of Dam). A spillway design test flood outflow of 1418 cfs (one-half of the probable maximum flood) will overtop the dam by approximately 0.93 ft. Due to the potential for overtopping, it is recommended that a definite plan for surveillance and a warning system be developed for use during periods of unusually heavy rains and runoff.

It is recommended that the Owner immediately engage the services of an engineer experienced in the design of dams to accomplish the following: develop and implement a program of redesign for the dam to provide adequate spillway capacity, freeboard, riprip protection, and outlet works capacity using current hydrologic criteria; institute repair and/or rehabilitation of the present outlet works gate in order that control of the water be maintained; examine the present seepage and surface erosion holes and design a system for collection of the flow and monitoring; initiate short term repairs to the spillway; develop and implement procedures to remove the rotting stumps and roots on the dam slopes; and institute a limited subsurface boring and testing program to accomplish the above. It is recommended

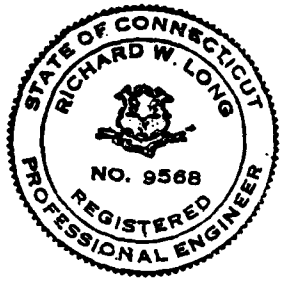
that the Owner also begin a regular program of inspection and maintenance including a plan of action for emergency situations.

The above recommendations should be implemented within 180 days after receipt of the Phase 1 Inspection Report. The alternative to these recommendations would be to drain Columbia Lake and maintain the water surface at a reduced level.

C-E MAGUIRE, INC.

by

Richard W. Long, P.E.
Vice President



This Phase I Inspection Report on the Columbia Lake Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Charles G. Tiersch

CHARLES G. TIERSCH, Chairman
Chief, Foundation and Materials Branch
Engineering Division

Fred J. Ravens Jr

FRED J. RAVENS, Jr., Member
Chief, Design Branch
Engineering Division

Saul Cooper

SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

SEP 29 1978

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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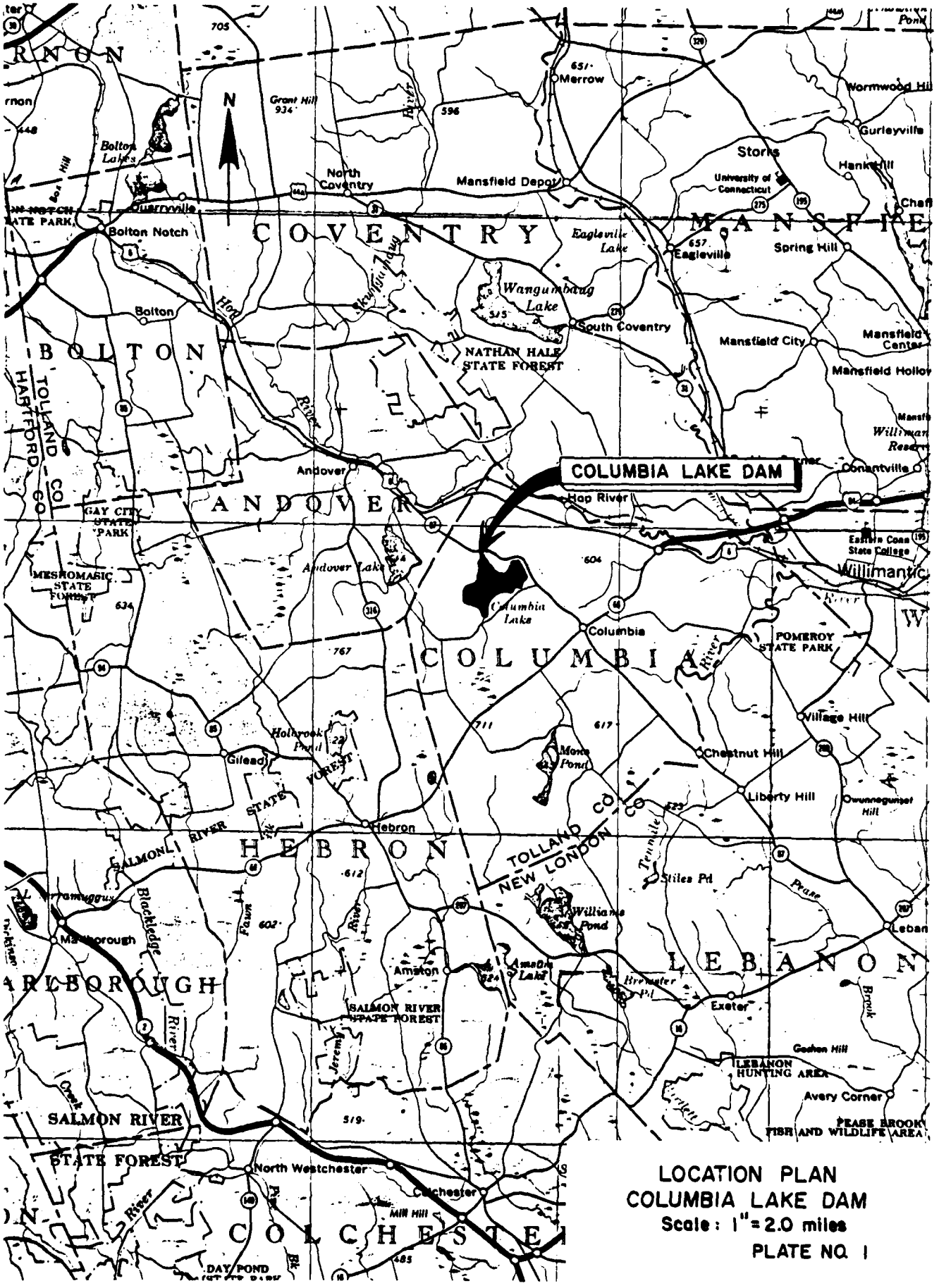


LOCATION PLAN
COLUMBIA LAKE DAM
Scale : 1"= 2.0 miles
PLATE NO. 1

PHASE I INSPECTION REPORT

COLUMBIA LAKE DAM CT 00520

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. CE Maguire, Inc., has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed was issued to C-E Maguire, inc., under a letter of 26 April, 1978, from Ralph T. Garver, Colonel, Corps of Engineers Contract No. DACW33-78-C-0300 has been assigned by the Corps of Engineers for this work.

b. Purpose

(1) Perform technical inspection and evaluation of non-Federal dams to identify conditions

which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.

(3) To update, verify and complete the National Inventory of Dams.

1.2 DESCRIPTION OF PROJECT:

a. Location: Columbia Lake is located in the Shetucket River watershed of the Thames River Basin, approximately 1.5 miles northwest of Columbia, Connecticut, in Tolland County. Columbia Lake has a surface area of approximately 270.0 acres, an average depth of 17.0 feet and a shoreline length of about 7.6 miles. The watershed of 3.1 square miles drains a rolling terrain which consists of swampland, woodland and farmland. The dam is located in the northwest corner of the lake parallel to, and approximately one hundred and eighty feet from, the highway embankment for Connecticut Route 87.

b. Description of Dam and Appurtenances: Based on visual inspection, the dam is an earth embankment

with a crest length of 295.0 feet (including spillway.) The upstream and downstream slopes are approximately 2.5 H : 1.0 V. The crest and the downstream slope are grassed. The upstream side is riprapped above water level and to a depth of at least 3.0 ft. below the water level. At the time of inspection, the water level was 1.1 feet below the crest.

The spillway is located on the extreme left side of the embankment and is a converging type contained between vertical rubble masonry walls. It is 26.0 feet wide by 260.0 feet long with a rubble stone bed that was filled with concrete. The right training wall is of grouted rubble and ranges from a height of 4.0 feet upstream to about 1.5 feet on the downstream side. The left training wall is of dry rubble construction with an average height of 9.0 feet. The spillway discharges from a rubble stone channel to a relatively small natural stream bed leading to a concrete box culvert 6.0 feet wide by 4.5 feet high under Route 87.

The intake gate for the outlet works is located on the outside face of a pier consisting of

vertical stone walls which have apparently been filled with earth. The pier is located to the right of center of the dam embankment, and it extends approximately 60.0 feet out into the lake. The gate is manually operated. The mechanical works are positioned on the extreme upstream end of the pier (see Photo C-6). The downstream end of the outlet is an 18-inch diameter cast iron pipe which discharges into a 40-inch wide by 16-inch high stone box culvert (see Photo C-7). The downstream channel is a natural streambed. It flows to the box culvert beneath Route 87 (see Photo C-8).

c. Size Classification: The dam is classified as intermediate in size because the impoundment at crest elevation is 3370 Ac.-Ft. which exceeds 1000 Ac.-Ft., the limiting criteria for intermediate size.

d. Hazard Classification: The dam is classified as a significant hazard potential because it is located in a predominantly rural or agricultural area where failure may damage isolated homes, secondary highways and some public utilities.

e. Ownership: Town of Columbia, Connecticut. The dam was built around 1865 by the Willimantic Linen Company to augment their water supply. Ownership was transferred to the Willimantic Linen Company (now called the American Thread Company) in 1898 and in 1933 the title was transferred to the present owner.

f. Gate Tender: Mr. Marshal Nuhfer
Nuhfer Drive
Columbia, Connecticut 06237
(203)-228-3018

g. Purpose of Dam: Columbia Lake is presently used solely for recreation.

h. Design and Construction History: Columbia Lake is an entirely artificial body of water. In the early 1800's, a small millpond was built near the present outlet to provide water power for a sawmill. In 1865, the Lake as it appears today was created when the Willimantic Linen Company of Willimantic, Connecticut (now the American Thread Company) built the currently existing larger dam. For the next 68 years (until the water rights were purchased in October, 1933, by the Town of

Columbia) the lake was used as a back-up source of water power. As manufacturing in Columbia slowly declined, the importance of the lake as a recreational attraction steadily increased.
In November, 1939 (as a result of the performance of the dam during the hurricane of September, 1938), following a directive from the State Board of Supervision of Dams for Connecticut, the dam was modified. The spillway was doubled in width from 13.0 feet to 26.0 feet and lined with "stone pavers." Records of that time also indicate that it was recommended that a 12-inch cut-off wall be installed beneath the spillway, penetrating 3.0 feet to 4.0 feet into hard material.

In April, 1963, it was recommended by a consultant to the State of Connecticut that all trees be removed from the embankment, debris cleared from the spillway, and an emergency spillway be excavated in natural ground at the right end of the embankment. An inspection of the dam in March, 1966, indicated that the trees and debris had been removed, but no emergency spillway had been excavated. In February, 1968, material was

added to the downstream slope above the toe wall and seeded. The top of the dam embankment was leveled, and an emergency spillway started. In August, 1968, the State of Connecticut, fearing possible overtopping of the dam based upon the performance of the dam during storms in March, 1968, directed that the emergency spillway be refilled to its former height.

Raising of the embankment 1.7 feet to provide additional freeboard, the addition of riprap on the upstream face, repairs to the spillway discharge and removal of trees and brush were recommended in September, 1971, by a consultant to the Water Resource Commission of the State. There were no observations made during visual inspection that would indicate that the dam has been raised subsequent to the 1971 recommendations. Therefore, the height of the dam now is apparently the same as in 1865.

i. Normal Operational Procedures: Water surface levels in Columbia Lake are normally lowered approximately 6.0 to 8.0 feet around October 1 of each year, after the recreational season ends, to protect shoreline docks and piers from ice damage.

This reduced level is maintained until late spring when ice is no longer a problem. At this time, the gate is closed and the run-off collected for the next recreational season. Normal pool elevation is 498.0 NGVD (National Geodetic Vertical Datum).

1.3 PERTINENT DATA

a. Drainage Area: The Columbia Lake drainage basin, located in eastern Connecticut, is generally elongated in shape and has a length of about 3.0 miles, an average width of 1.0 mile, and a total drainage area of 3.1 square miles. The topography is generally rolling hills with hilltops at Elevation 700±. Basin slopes are generally flat to moderate. A large swamp area (0.2 square miles) in the upper reaches of the watershed tends to dampen the effect of surface run-off from the steeper slopes of the wooded hillsides. A general basin map is enclosed, see Appendix D.

b. Discharge at Dam Site: The largest storm experienced at the Columbia Lake Dam was the September, 1938 hurricane. Calculations prepared by the State of Connecticut in 1968 indicate that with the spillway 13.0 feet in width and the water level

approaching the top of the dam, the estimated discharge was 270 cfs during the 1938 hurricane. It is estimated that 960 cfs will flow into the reservoir due to a 100 year frequency storm event. This peak inflow rate is reduced by storage to produce an outflow of 132 cfs at the spillway, which is now 26.0 feet wide as computed by the Soil Conservation Service technique. The spillway design test flood (1/2 Probable Maximum Flood) as calculated in Appendix D is 3120 cfs and 1418 cfs as inflow and outflow, respectively based upon 1000 CSM as inflow value. Listed below are discharge data for spillway and outlet works:

1. Outlet works (conduit) size 18 inch diameter. Cast iron pipe with invert Elevation 471.0±
2. Maximum known flood at dam site 270 cfs in 1938.
3. Spillway capacity at maximum pool level (Elevation 502.0) - 624 cfs.
4. Gated outlet capacity at normal pool elevation with an open 18-inch diameter cast-iron pipe 73.0 cfs, with reservoir, at Elevation 498.0 and tail water at Elevation 471.0.

5. Gated outlet capacity at maximum pool level (Elevation 502.0) - 77 cfs.

6. Total discharge (spillway and outlet) capacity at maximum pool level (Elevation 502.0) - 701 cfs.

c. Elevations: (feet above NGVD)

1. Top of Dam - Elevation 502.0

2. Maximum pool-design surcharge - 4.0 feet with no freeboard

3. Full flood control pool - Elevation 502.0 with no freeboard

4. Recreation pool - Elevation 498.0

5. Spillway crest - Elevation 498.0

6. Upstream invert of intake structure - Elevation 471.0 (estimated) - 27 feet ± below normal pool level

7. Estimated elevations of streambed at centerline of dam upstream 471.0, downstream 470.0

8. Maximum tailwater - not computed

d. Reservoir Lengths: (feet)

1. Length of maximum pool - 5,600

2. Length of recreational pool - 5,600

3. Length of flood control pool - 5,600

e. Reservoir Storage: (acre-feet)

1. Recreation pool - 3,370 at Elevation 498.0
2. Flood control pool - 1,080 at Elevation 502.0
3. Surcharge - 1,080 between Elevation 498.0 and 502.0.
4. Top of dam - 4450 at Elevation 502.0.
5. Flood control pool of 1080.0 Ac.-Ft. represents 6.50 inches of runoff from the 3.12 Sq. Mi. Basin.

f. Reservoir Surface: (acres)

1. Top of dam - 270
2. Maximum pool - 270
3. Flood-control pool - 270
4. Recreational pool - 270
5. Spillway crest - 270
6. One foot of surcharge represents 1.62 inches of runoff from its drainage area of 3.12 Sq. Mile.

g. Dam

1. Type - Probably earth, because emergency spillway excavation was apparently made in earth and exposed surfaces are of earth.

2. Length - 295.0 feet (including spillway)

3. Height - 28.0 feet from streambed (downstream)

4. Top Width - 16.0 feet

5. Side slopes - 1 vertical on 2.5 horizontal (scaled)

6. Zoning - Unknown

7. Impervious Core - Unknown

8. Cut-off - Unknown. Correspondence indicates that a concrete cut-off 3 to 4 feet deep may exist beneath the spillway)

9. Grout curtain - Unknown

10. Other - Dry, cut-stone toe wall 6 to 10 feet high

h. Spillway

1. Type - Curved, converging, broad-crested, overflow spillway

2. Length of weir - 26.0 feet maximum normal to the flow converging to 16.0 feet

3. Crest elevation - Elevation 498.0

4. Gates - None

5. Upstream Channel - Straight, natural bed

i. Regulating outlet

1. Invert Elev. 471.0±

2. Size - 18" dia.

3. Description - Cast Iron Pipe

4. Control Mechanism-Manually operated vertical slide gate

5. Other - ---

SECTION 2

ENGINEERING DATA

2.1 DESIGN

A topographic survey of the dam embankment conducted by T.A. Brindamour in June, 1968 is the only engineering data available. Elevations indicated on the topographic map resulting from this survey were not verified during this Phase I study.

2.2 CONSTRUCTION RECORDS

No data available.

2.3 OPERATION RECORDS

No data avilable.

2.4 EVALUATION OF DATA

a. Availability - Limited to data mentioned in 2.1.

b. Adequacy - Not adequate

c. Validity - Not verified

SECTION 3

VISUAL INSPECTION

3.1 FINDINGS

a. General: At the time of the inspection, it appeared that the dam had recently been trimmed of brush and undergrowth and the downstream channel and terrain cleared. Fencing at the entrance to the access road and private property abutting the damsite has prevented surface erosion from trespass. It was observed that an attempt had been made in the past to repair the spillway bed using dumped concrete, but undermining of that slab is apparent. The masonry of the spillway training walls, particularly at the downstream ends, was dislodged and obstructing the bed of the spillway. Surface erosion holes in the crest of the outlet gate pier structure were observed. In general, it appeared that the condition of the dam was declining and not being properly maintained.

b. Dam: Seepage at rates ranging up to several gallons per minute was observed emanating from the downstream side of the dam at locations indicated on Plate No. 3 and shown in Photographs Nos. C-5 and C-10.

Numerous stumps and, hence, rotting roots were present on the upstream and downstream slope. Photographs were taken of some stumps and appear in Photograph No. C-9.

An emergency spillway that was excavated on the dam crest, according to correspondence, appears to either have been incompletely backfilled or settled, as there is a definite low spot at present at that location.

The outside perimeter of the 18 inch diameter cast-iron-pipe outlet conduit at the base of the dam was wet, indicating that seepage may be occurring along its perimeter.

c. Appurtenant Structures: Surface erosion holes up to 2.75 feet deep were found on the upstream end of the gate support structure. See Plate No. 3 for locations and Photograph No.C-11.

Surface erosion holes were also found along the westerly spillway wall immediately west of the stonework. These are very likely due to loss of soil from openings between stones resulting from inadequate filter material between the stonework and the soil. The spillway was found to be seriously undermined and inadequate in size. Training

walls were collapsed and dislodged on the downstream discharge slope of the spillway.

The intake control of the outlet works was reportedly leaking severely, requiring alternate means to stop the leakage. These alternate means were reported to be dumped cinders adjacent to the gate.

d. Reservoir Area: Gneiss bedrock was exposed 50 feet upstream from the right abutment of the dam embankment. At this location it is planar and dips at an angle of 10° in the direction N 80° W. A one-half inch wide nearly vertical joint in the rock is exposed. Its intersection with the horizontal plane strikes N 50° W, toward the highest part of the dam. The alignment of this joint with the main embankment intersects at a point which projected to the downstream toe lies near the seep area indicated on Plate No. 3 and could be the cause of that flow.

e. Downstream Channel: The downstream channel is irregular and overgrown with trees. The bed of the channel is stained with a rust colored deposit. Several channels have been formed by the flowing water that emanates from the downstream

side of the dam. The beds of these channels are also rust-stained.

3.2 EVALUATION

Visual observation made during the course of the inspection did not indicate any conditions of an immediate critical nature. Several of the deficiences observed and discussed above require attention and should be corrected before further deterioration develops a hazardous condition. Recommended measures are discussed in Section 7.

SECTION 4

OPERATIONAL PROCEDURES

4.1 PROCEDURES

a. Normal Operating Procedures: Columbia Lake is presently used primarily for recreational purposes. Regulation of the water level in the lake is synchronized with the summer boating and bathing season. Operation of the control outlet gate (which is always locked) is accomplished by a lake-front resident, Mr. Marshal Nuhfer, for the Town of Columbia. Generally, around the beginning of October the water level is lowered from Elevation 498.0 (Spillway Crest) approximately six to eight feet and held at that reduced level by

intermittent gate openings until the danger from ice damage to shorefront docks and piers has passed in the spring. Depending on the severity of the winter, the gates are closed on or about mid-March in order to raise the level back to its summer use stage. There are no other outlets to the impoundment.

b. Emergency Operating Procedures: Impending intense rainfalls from approaching storms are monitored by the gate tender, the Town road foreman and the Selectmen through local radio or television forecasts or direct contact with the weather bureau. Keys to the control gate are held by the gate tender and the road foreman. No formal procedure exists for emergency situations. The necessary control is based on a judgment made by the keyholders or by the Selectmen. No records or graphs exist indicating past discharge or water levels.

4.2 MAINTENANCE OF DAM

Maintenance of the dam has been neglected and has occured generally only when directed by the State as a result of their inspections.

4.3 MAINTENANCE OF OPERATING FACILITIES

Monitoring the need for maintenance of the gate control is generally the responsibility of the gate tender. The intake control mechanism is an aged mechanical structure exposed to weather and vandalism. Problems with closing the gate and leakage through the outlet pipe have been reported annually. Proposals for repairing the gate were requested by the Town in 1972, but no action was taken. On the downstream side, the outlet lies within the embankment toe and could be blocked or completely obstructed by the occurrence of a small slide or dislogement of stones.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

No formal warning system is used, but rather the gate operator, using public weather forecasts, judges the emergency and operates the gate accordingly. There is no pre-planned effective warning system for the failure of Columbia Lake Dam. An emergency action plan must be developed in order that operating personnel can notify authorities for mobilization of State and local emergency forces, organize remedial measures to minimize or prevent complete failures when possible and have an awareness of the locations of standby equipment and materials.

4.5 EVALUATION

The dam and its appurtenances have been seriously neglected. There is no record of a formal program of inspection or maintenance conducted by the Owners nor is there a definitive contingency plan for emergency situations.

SECTION 5

HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data: No specific design data is available. In lieu of existing design information, the U.S.G.S. topographic maps (Columbia Lake Quadrangle) were used to develop hydrologic parameters. Outflow for the Spillway Design Flood was developed using approximate routing parameters with the lake at spillway crest level (see Appendix D). Pertinent hydraulic design data was obtained and/or confirmed for the spillway, outlet and other appurtenant structures by actual field measurements. The dam failure profile was developed from the above mentioned topographic mapping. Surcharge storage was approximated assuming that the lake surface area remained constant above spillway crest elevation (as required by Corps) The results of the flood routing are as follows:

INFLOW, OUTFLOW AND SURCHARGE DATA

FREQUENCY IN YEARS	24-HOUR TOTAL RAINFALL IN INCHES	24-HOUR* EFFECTIVE RAINFALL IN INCHES	MAXIMUM INFLOW IN C.F.S.	MAXIMUM** OUTFLOW IN C.F.S.	SURCHARGE STORAGE IN FEET	SURCHARGE STORAGE ELEVATION
10	5.0	2.6	560	56	0.80	498.80
50	6.5	4.1	860	110	1.26	499.26
100	7.0	4.6	960	132	1.42	499.42
1/2 MPF = TEST FLOOD	11.9	9.5	3120	1418	4.93	502.93

*Infiltration assumed as 0.1"/hour

**Lake assumed initially full at spillway crest elevation 498.0
(Top of dam = 502.0 .)

NOTES:

1. Q_{10};Q_{50};Q_{100}; inflow discharges computed by approximate methodology of Soil Conservation Service.
2. 1/2 MPF and "test flood" computation based on COE instructions and guidelines.
3. Maximum capacity of spillway without overtopping the top of the dam elevation 502.0 is equal to 624 C.F.S.
4. All discharges indicated are dependent upon the continued integrity of upstream storage reservoirs.
5. Surcharge storage is allowed to overtop the dam when exceeding the spillway capacity.

b. Experience Data

1. Spillway:

1938 Flood	Q outflow = 270 cfs
	Surcharge = 2.75 feet (estimated)

The Dam was sandbagged to prevent overtopping. Water levels approached within one foot of the dam crest elevation. As a result of this flood the spillway was doubled in size.

1955 Flood	No records available
1968 Flood	Q outflow = 65 cfs (estimated)
	Surcharge = 0.75 feet

2. Outlet and Intake Structure: A vertical pier which extends approximately 60 feet out into the lake is oriented normal to and flush with the top of the embankment and contains the control mechanism for the outlet. This consists of an old manual hoist, which, through a series of gears, lifts vertically an 8.0 inch wooden gate post. The only information available for the assembly in which the gate seats is a sketch made by a diver in May, 1968. This sketch indicates that the gate rides in a tapered

slot on the face of the pier. The gate seats in front of the outlet conduit. A timber trash rack in front of the gate was in bad disrepair according to the diver survey. (See attached sketches - Appendix B). Seating of this gate has become a serious problem.

c. Visual Observations:

1. Spillway bed is undermined and in poor condition.
2. Spillway training walls are eroded, dislodged and collapsed on the downstream slope.
3. Intake control structure is in urgent need of repairs.
4. Emergency spillway was refilled and no longer exists, but filling was incomplete or settlement of the placed material has occurred, leaving a low spot in the crest of the dam.

d. Overtopping Potential: Spillway is hydraulically inadequate and structurally unsafe to pass the Spillway Design Flood. The surcharge created by this Flood will overtop the lowest point on the dam crest by approximately 0.90± feet. The 100-

year storm event with hurricane-type winds will produce wave set-up and ride-up that would be dangerous to the dam because of inadequate free-board. The upstream face of the dam requires additional slope protection for wave action. The maximum discharge capacity of the spillway without overtopping the dam is 624 cfs which is 44% of the test flood outflow discharge of 1418 c.f.s. See Appendix D for Spillway Rating Curve.

SECTION 6

STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations: There were several signs of structural distress evident during the visual inspection that are discussed in various sections of this report (seepage, spillway slab, spillway, training walls, outlet works pier, etc.)

b. Design and Construction Data: No such data are available and an evaluation cannot be made.

c. Operating Records: The gatekeeper has indicated that 12-inch size stones with mortar on them passed out of the 18-inch cast iron discharge conduit. No evidence of such major damage was visible at the time of the inspection. The

surface erosion holes mentioned in Section 3.1 (c) may be related to such losses.

d. Post-Construction Changes: Available correspondence indicates that sandbags were placed on the crest during the 1938 hurricane, but that those sandbags were not found to be needed. After the hurricane, the spillway was widened from 13.0 feet to its present 26.0 feet and a concrete cutoff 3 to 4 feet deep was apparently placed beneath the spillway channel at an unrecorded location.

An emergency spillway was cut into the right side of the dam. The bottom of the channel, which was unlined, was 2.0 feet above the present spillway channel, according to the correspondence. This emergency spillway was subsequently filled with earth of an unspecified type in an unspecified manner by Town of Columbia work crews.

Trees up to 20 inches in diameter were allowed to grow in substantial numbers on the upstream and downstream sides of the dam. Subsequently, these trees were cut, leaving stumps and roots that are now rotting. The brush was most recently cleared from the downstream face of the dam in the fall of 1977, so that at the time of the inspection,

there was no brush present, only grass and low growth up to about 18 inches in height.

The downstream face of the dam was, according to the correspondence, flattened to its present slope by adding fill. The fill type was not specified, nor was the method of placement. The fill was added in a wedge from the crest to the top of the toe wall in an apparent effort to make the dam more stable. Placement of such additional weight above the toe wall reduces the stability of the downstream slope. If this fill is less pervious than the embankment itself, then the stability of the downstream slope would be reduced. Only if the fill were equally or more pervious than the embankment, and if it extends down beyond the toe wall, would the downstream slope stability be improved.

e. Seismic Stability: This dam is in seismic Zone 1 and, hence, does not have to be evaluated for seismic stability according to the Recommended Guidelines.

SECTION 7

ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Condition: Based on the visual inspection, records available of the site and past operational performance, the dam is judged to be in poor condition. A review of the limited data available reveals that there are areas of concern which must be corrected in order to assure the long term performance of the dam. These concerns are as follows:

1. The spillway bed is undermined over a substantial area, has steep, unprotected downstream slopes with loose rubble masonry which is generally dislodged, settled or eroded. Prior patching with dumped concrete has been ineffective. High impoundment levels cause flow beneath the spillway floor slab. These flows could produce serious undermining and erosion and could lead to subsequent failure of the dam.

2. Surface erosion holes adjacent to the operating mechanism at the upstream end

of the gate support structure may be due to erosion through holes in the masonry or into the discharge conduit. Observable evidence at the site does not indicate which way the material is being lost. Loss of material through the outlet would be dangerous to the integrity of the dam.

3. It was reported that closing the gate of the outlet works has become increasingly difficult with leakage and possible clogging occurring. In April of this year it was reported that, to prevent this leakage, cinders were dumped immediately upstream of the gate face. Unless immediate repair to the gate is undertaken, water levels cannot be controlled.

4. Large trees were allowed to grow on both embankment faces and were subsequently cut. Roots of these trees located on both the upstream and downstream dam slopes continuously rot and form increasingly dangerous discontinuities in the embankment where seepage and erosion

may concentrate. These stumps should be given special attention during future inspections to watch for any signs of developing seepage, until a program for their subsequent removal has been developed. It is particularly important that embankment slopes be well maintained in order that inspectors can closely discern changes that may occur.

5. Significant seepage was observed exiting from several locations along the downstream toe of the dam and from the abutments. Seepage was observed and reported to flow under the spillway floor slab and to exit on the downstream slope of that channel. The zone outside of the 18 inch diameter discharge conduit on the downstream end was wet. Although these seepage conditions may have been occurring for many years, continued seepage aggravated by a rise in the water level behind this dam may, over a period of time, lead to internal erosion (piping) of the dam.

6. The spillway capacity does not satisfy the screening criteria established by the Corps of Engineers for the Spillway Design Flood. The adopted storm event (1/2 Probable Maximum Flood) overtops this dam. The freeboard allowance is also inadequate for the 100-year recurrence interval storm event (see Appendix D).

7. Both east and west spillway training walls on the downstream slope show significant signs of wear with stones dislodged, or collapsed into the spillway bed.

8. There is no proper and regular maintenance and inspection program for the dam, nor is there a formal warning system for emergency situations.

B. Adequacy of Information: The information available is such that the assessment of the condition of this dam must be based primarily on the visual inspection and the past operational performance of the structure.

C. Urgency: It is considered that the recommendations suggested below be implemented

within 180 days of receipt of this Phase 1 report.

D. Need for Additional Information: There is no evidence that formal engineering analyses were ever performed for this dam. The visual inspection and operational history indicate that attention should be given to the collection of current data in order that the recommendations listed below may be implemented.

7.2 RECOMMENDATIONS

a. Facilities: In view of the concerns for the condition of Columbia Lake Dam, and the lack of engineering backup data, it is recommended that the following measures be undertaken by the Owner.

1. Engage the services of an engineer experienced in the design of earthen dams to collect, analyze and develop designs to accomplish these recommendations.
2. Institute immediately an analysis for the short term repair and/or rehabilitation of the present outlet works gate in order that control of the water level can be maintained.

3. Initiate an examination and design to develop and implement short term repairs to the spillway to prevent further undermining and potential erosion.

4. Examine the present seepage emanating from the downstream toe and design a system for collection and monitoring this flow in order that changes in flow quantity and sediment transport can be detected.

5. Investigate the cause and correct the surface erosion holes on the gate mechanism pier.

6. Redesign and reconstruct the dam to provide adequate spillway capacity, surcharge storage capability, freeboard, slope protection and outlet works capacity using current hydrolic criteria.

7. Implement immediately a limited subsurface boring and testing program to accomplish the above items.

7.3 REMEDIAL MEASURES

a. Alternatives: As an alternate to the immediate commencement of studies to upgrade the structure Columbia Lake water surface levels should

be lowered and maintained at a level well below the spillway crest. That reduced level should be controlled to provide storage for storm events.

b. Operations and Maintenance Procedures: While the dam has had some maintenance, it is considered important that the following items be attended to as early as is practical:

1. Develop and commence a regular inspection and maintenance schedule for the facility.
2. Incorporate in the above program monitoring of the seepage and examination of the tree stumps on the slopes. Once a procedure has been developed for the removal of the rotting stumps and roots, incorporate this procedure into the regular maintenance program.
3. Develop a system for the recording of data with regard to items such as: water levels, discharges, time and drawdown to assist those responsible for the monitoring of the structure.
4. Prepare an "Emergency Action Plan" to prevent or minimize the impact of failure,

listing the expedient action to be taken and authorities to be contacted.

5. Because of the concerns for this dam and the limited data available, an around-the-clock surveillance should be instituted during periods of high precipitation.

APPENDIX A

VISUAL INSPECTION CHECK LIST

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT COLUMBIA LAKE DAM

DATE 18 MAY 1978

TIME 0830 - 1630

WEATHER CLOUDY - RAIN

W.S.ELEV. _____ U.S. _____ D.S.

PARTY :

1.	R.W. LONG	CEM	6.	SAT KHANNA	CEM
2.	E.A. REED	CEM	7.		
3.	S. POULOS	GEI	8.		
4.	R. BROWN	CEM	9.		
5.	V. GALGOWSKI	STATE OF CONN.	10.		

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECK LIST

PROJECT COLUMBIA LAKE DAM DATE 18 MAY 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation	Elevation 502.0
Current Pool Elevation	Elevation 498.0
Maximum Impoundment to Date	See Section 1
Surface Cracks	None observed
Pavement Condition	No pavement, grass covered
Movement or Settlement of Crest	Depression about 6' to right of spillway wall on top of crest. About 3" below up and downstream crest line.
Lateral Movement	None observed
Vertical Alignment	Surface is too irregular to judge alignment. No pronounced misalignment observable.
Horizontal Alignment	
Condition at Abutment and at Structures	At right abutment dumped fill used to seal emergency spillway. Slight depression in this zone. Fill could be loose. Left abutment is spillway wall.
Indications of Movement of Structural Items on Slopes	None observed.
Trespassing on Slopes	Free Access. Crest grass is worn thin.
Sloughing or Erosion of Slopes or Abutments	Downstream slope very slightly gullied by surface erosion. One animal hole downstream just above toe wall.
Rock Slope Protection - Reprap Failures	Riprap sloughing to left of upstream jetty. Slope is eroded from wave action.
Unusual Movement or Cracking at or near Toes	None Observed

PERIODIC INSPECTION CHECK LIST

PROJECT COLUMBIA LAKE DAM DATE 18 May 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Unusual Embankment or Downstream Seepage	Several seeps downstream on left and right sides. All appear to be silt free
Piping or Boils	None observed
Foundation Drainage Features	None
Toe Drains	None
Vegetation	Several old stumps on both faces. Rotting.
Instrumentation System A-2	None

PERIODIC INSPECTION CHECK LIST

PROJECT COLUMBIA LAKE DAM DATE 18 MAY 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	Riprap apron
General Condition	Poor to fair
Loose Rock Overhanging Channel	None observed
Trees Overhanging Channel	None observed
Floor of Approach Channel	Natural w/riprap apron grouted
b. Weir and Training Walls	
General Concition of Concrete	Dry rubble walls westerly side good except for downstream end. Grouted rubble wall easterly side good except for downstream end. Slab - Grouted stone, poor condition undermined. Downstream end bad
Rust or Staining	None observed
Spalling	N/A
Any Visible Reinforcing	None observed
Any Seepage or Efflorescence	None observed
Drain Holes	N/A
c. Discharge Channel	
General Condition	Poor
Loose Rock Overhanging Channel	Yes - Retaining wall (not natural rock cut).
Trees Overhanging Channel	Recently cleared + overhanging trees.
Floor of Channel	Natural- Partially obstructed with boulders
Other Obstructions	Downstream highway culvert

PERIODIC INSPECTION CHECK LIST

PROJECT COLUMBIA LAKE DAM DATE 18 MAY 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL PIER	
a. Concrete and Structural	
General Condition	Dry rubble construction earth filled poor to fair.
Condition of Joints	Open joints ungrouted
Spalling	N/A
Visible Reinforcing	N/A
Rusting or Staining or Concrete	None observed
Any Seepage or Efflorescence	Sinkholes around gate control Mechanism
Joint Alignment	N/A
Unusual Seepage or Leaks in Gate Chamber	Considerable leakage noticed on downstream face in area of outlet pipe could be unseated gate, or cracks in pipe, etc.
Cracks	None observed
Rusting or Corrosion of Steel	Rusting observed in discharge water or downstream face.
b. Mechanical	
Air Vents	Manually operated gate. Locked. Exposed to weather. Rusted. Last operated in April, 1978 and problems in seating occurred. Finally sealed by dumping cinders. Gates and trash rack are wooden and reportedly in need of repair or replacement.
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	

PERIODIC INSPECTION CHECK LIST

PROJECT COLUMBIA LAKE DAM DATE 18 MAY 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL PIER (cont.)	
Emergency Gates	None
Lightning Protection system	None
Emergency Power System	None
Wiring and Lighting System in gatehouse.	None

PERIODIC INSPECTION CHECK LIST

PROJECT COLUMBIA LAKE DATE 18 MAY 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	
Slope Conditions	Not observed. Below water.
Bottom Conditions	Not observed. Below water.
Rock Slides or Falls	Not observed. Below water.
Log Boom	None.
Debris	Not observed. Below water.
Condition of Concrete Lining	Not observed. Below water.
Drains or Weep Holes	Not observed. Below water.
b. Intake Structure	Stone faced, earth filled pier on upstream face jutting out into Columbia Lake. Trash rack, and gate mechanism located in southerly tip of pier. Inspected as part of dam.
Condtion of Concrete	Not observed. Underwater.
Stop Logs and Slots	In wet well of chamber. Not observed.

PERIODIC INSPECTION CHECK LIST

PROJECT COLUMBIA LAKE DATE 18 MAY 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - CONDUIT	
General Condition of Concrete	Conduit - 18" diameter cast iron pipe at downstream end. Appears to be rusted and mishapen at the outlet on the downstream face.
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

PERIODIC INSPECTION CHECK LIST

PROJECT COLUMBIA LAKE DATE 18 MAY 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of stone masonry	Dry stone box culvert 16" x 40"
Rust or Staining	Considerable rust staining from outlet
Spalling	
Erosion or Cavitation	
Visible Reinforcing	Dry rubble construction enclosing a pipe.
Any Seepage or Efflorescence	Considerable seepage noted.
Condition at Joints	
Drain holes	
Channel	Natural earth channel
Loose Rock or Trees Overhanging Channel	Yes
Condition of Discharge Channel	Poor to fair

APPENDIX B

I. Records for dam can be found at:

1. Town Hall, Box 165, Columbia, CT 06237
2. Department of Environmental Protection
   State of Connecticut
   State Office Building
   Hartford, Connecticut 06115
   Attention: Mr. Victor Galgowski,
   Dam Safety Engineer
   Water and Related Resources Unit

II. Inspection Correspondence

III. Sketches, Drawings

MOZZOCHI ASSOCIATES
CIVIL ENGINEERS

GLASTONBURY, CONN. 06033
317 HEBRON AVENUE
PHONE 633-9401

PROVIDENCE, R. I. 02903
169 WEYBOSSET STREET
PHONE 421-0420

PARTNERS
JOHN LUCHS, JR.
STUART J. BECKERMAN

REPLY TO: Glastonbury

September 22, 1971

William H. O'Brien, III
Civil Engineer
Water Resource Commission
State Office Building
Hartford, Connecticut 06115

STATE WATER RESOURCES COMMISSION
RECEIVED
SEP 23 1971

ANSWERED _____
REFERRED _____
FILED _____

Re: Columbia Lake Dam
Columbia, Connecticut
Our File #57-73-43

Dear Mr. O'Brien:

Reference is made to our report of April 17th, 1970, for this dam. This letter reported on the hydraulics of the present structure with several recommendations.

I revisited the site on September 7th, 1971 and noted the following:

1. Several large trees were up-rooted by the recent strong winds (August 28th, 1971).

2. The spillway is partially clogged with branches from a tree that was felled and cut up recently on property to the west of the spillway.

3. Growth is beginning to reappear on the embankment. Sassafras, wild cherry and other trees are taking root.

4. The area at the easterly end of the embankment, which once qualified as a crude emergency spillway, has been filled in and is presently higher than the rest of the embankment.

5. Exit channel below level control section deteriorating.

The hydraulics for this structure were checked again and determined to be correct. In light of your letter to check the stability of the emergency spillway and my recent visit, the following recommendations are

made:

1. Raise embankment 1.7 feet to provide 3' freeboard and add riprap protection.

2. Exit channel below control level section should be repaired. It is recommended that concrete be used to fill voids between the stones (as has been done on the control section) to hold in position. Velocity varies from 9 to 15 feet per second dictating additional protection.

3. Remove fallen trees and brush from the downstream area.

4. Initiate a maintenance program for the structure.

Very truly yours,

MOZZOCHI ASSOCIATES

By _____
John Luchs, Jr., Senior Partner

JLJr:ed
file

MOZZOCHI ASSOCIATES
CIVIL ENGINEERS

PARTNERS
JOHN LUCHS, JR.
STUART J. BECKERMAN

GLASTONBURY, CONN. 06033
317 HEBRON AVENUE
PHONE 633-6401

PROVIDENCE, R. I. 02903
166 WEYBOSSET STREET
PHONE 421-0420

REPLY TO: Glastonbury

April 17, 1970

William H. O'Brien III, Civil Engineer
Water Resources Commission
State Office Building
Hartford, Connecticut 06115

Re: Columbia Lake Dam
Columbia, Connecticut
Our File #57-73-43

Dear Mr. O'Brien:

The [illegible] dam was inspected on March 3, 1970 to verify dimensions [illegible] sketch prepared by Mr. John J. Mozzochi in 1963.

It is an earth dam [illegible] high with a 16'± top width, [illegible] in the downstream and upstream. The level concrete section is 30'± in length and 24'± wide. The inlet flares to 36'± and the downstream section drops off sharply and leads to a 4'-6" x 6'-0" box culvert under the roadway crossing the valley downstream [illegible].

The [illegible] spillway are vertical dry wall construction and [illegible] (telford type). The spillway crest is 4'-6" [illegible] top of the dam. There is a draw-down conduit (stone construction [illegible] downstream toe) 1'-6"± x 2'-0" with a gate in a shaft-type [illegible] protruding into the lake to control the water level. [illegible] ignored in our calculations as insignificant.

[illegible] total watershed area of three square miles and a water [illegible] acres. [illegible] normal water surface elevation. Flood routing [illegible] to check the capacity of the existing spillway [illegible] available Technocrat for the following:

. 50 y[illegible] - 6 hour duration
. 10[illegible] - 6 hour duration
. 1/2 [illegible] storm - 6 hour duration

[illegible] studies are tabulated below.

STATE WATER COMMISSION
RECEIVED
APR [illegible] 1970
FILE NO. _____
ACTION _____
BY _____

TYPE OF STORM	RAINFALL (inches)	DIRECT RUN-OFF (inches)	MAX. WATER SURFACE ELEVATION ABOVE SPILLWAY CREST (feet)	FREEBOARD (feet)
50 yrs storm 6 hrs duration	4.5	2.9	1.6	2.6
100 yrs storm 6 hrs duration	5.1	3.5	1.9	2.3
1.5 x 100 yrs storm 6 hrs duration	7.6	5.8	2.9	1.3

With a fetch of 1 mile of open water, a minimum of 3' of ripraped freeboard is prudent and some corrective measures are required to attain this. Refering to Mozzochi's letter dated April 25, 1963, the followin recommendations are in substantial agreement.

1. Provide additional spillway on the easterly end of dam or raise top of dam..
2. Clean debris from area between dam embankment and road embankment to prevent clogging of the 4'x6' box culvert under thos road.

Very truly yours,

MOZZOCHI ASSOCIATES

By _____
John Lucas, Jr. - Partner

JL:jr/ed
file

INTERDEPARTMENT MAIL

DATE DECEMBER 7, 1967

TO FILE | DEPARTMENT WRC

FROM WILLIAM H. O'BRIEN | DEPARTMENT WRC

SUBJECT COLUMBIA LAKE DAM, COLUMBIA

On December 6, 1967, the undersigned visited the above dam and made the following observations:

1. The water level had been lowered several feet below normal, I assume to allow property owners to make repairs to docks, etc.
2. It appeared that some work had been done in constructing an emergency spillway on the east end of the dike. In any event, there was a low area at the extreme easterly section of the dam which was approximately 25 feet in width and at an elevation approximately 2 feet above normal pond level. However, there was a pile of dirt in the middle of this "spillway" and there was no protection of the side slopes of this spillway. The intent of suggesting an emergency spillway in this area was apparently to take advantage of a low area formed by the access road to the dam from Route #87. In fact, with suitable erosion protection, part of this roadway could be used as part of the emergency spillway channel. In any event, the emergency spillway was in no way complete, but it appeared that it could be with a minimum of effort.
3. There was a 12 inch tree growing very close to the outlet end of the drawdown structure which should be cut down.
4. There was a great deal of debris in the lower principal spillway channel such as fallen rocks, and small trees and some brush. This should be cleaned up.
5. Apparently no work in flattening the down-stream slope had been done.

WILLIAM H. O'BRIEN
CIVIL ENGINEER

JOHN J. MOZZOCHI AND ASSOCIATES
CIVIL ENGINEERS

GLASTONBURY, CONN.
217 HEBRON AVENUE
PHONE 633-6401

PROVIDENCE 3, R. I.
198 DYER STREET
PHONE GASPEE 1-0420

JOHN J. MOZZOCHI
ASSOCIATES
OWEN J. WHITE
JOHN LUCAS, JR.
ECTOR L. GIOVANNINI

March 11, 1966

REPLY TO: Glastonbury

William H. O'Brien, III
Water Resources Commission
State Office Building
Hartford, Connecticut 06115

Re: Our File 57-73-43
Columbia Lake Dam

Dear Mr. O'Brien:

In accordance with your instructions of March 7th, I re-inspected the referenced dam on March 8th and found that Items No. 1, Remove all trees from the embankment, and Item No. 2, Remove all debris from spillway, (as called for in my report of April 25, 1963) have been accomplished satisfactorily. The other items calling for an emergency spillway and flattening of the downstream slope have not been accomplished.

I suggest that this matter be called to the Town's attention, as soon as possible.

Very truly yours,

John J. Mozzochi and Associates
Civil Engineers

JJM:hk

JOHN J. MOZZOCHI AND ASSOCIATES
CIVIL ENGINEERS

GLASTONBURY, CONN.
217 HEBRON AVENUE
PHONE 633-0401

PROVIDENCE 3, R. I.
100 DYER STREET
PHONE GASPEE 1-0420

JOHN J. MOZZOCHI
ASSOCIATES
OWEN J. WHITE
JOHN LUCHS, JR.
ECTOR L. GIOVANNINI

April 25, 1963

REPLY TO: Glastonbury

William S. Wise-Director
Water Resources Commission
State Office Building
Hartford 15, Connecticut

Re: Our File 57-73-43
Columbia Lake Dam
Columbia, Connecticut

Dear Mr. Wise:

As per instructions received from Robert McCabe, I contacted Mr. Clair Robinson, First Selectman of Columbia, and made an inspection of the referenced dam on April 24th. This is a town-owned structure.

Mr. Robinson has been selectman in Columbia for 42 years and is very well acquainte with the recent history of the dam. He informs me that in 1938, the dam was sand-bagged to prevent it from being overtopped and that a wash-out occurred at the easterly end of the embankment. This washout was refilled but apparently to an elevation that is now higher than the dam.

This is an earthen dam about 260' long with a maximum height of about 25 - 30 feet. It has a spillway about 26' wide and 40' long with a freeboard of 4 feet. The lake has an area of about 270 acres and a clear reach of about a mile south of the dam. The town has riprapped the lake side of the dam against wave action. There is an excellent sod cover on top of the dam but there are also numerous large diameter trees growing thereon. The downstream slope of the dam appears to be steeper than a 2 to 1 slope. A drawdown gate is in good operating condition and is opened each Fall to lower the pond level through the winter. However, the discharge opening downstream is only 1-1/2' x 2' and therefore adds only slightly to the capacity of the spillway.

With a minimum freeboard of 1 foot, I calculated the discharge capacity of the spillway at 360 C.F.S. For a total drainage area of 3.1 sq. miles, I believe this spillway has insufficient capacity as already indicated by the experience in 1938.

I recommend the following actions be required:

1. Remove all trees from the embankment;
2. Remove all debris from the spillway;
3. Excavate an emergency spillway at the east end of the dike in natural ground, even though it may be ledge, at an elevation of about 1-1/2 feet above the main spillway and at a minimum width of 25 feet;

4. Flatten the downstream slope of the dam to a slope of 3 horizontal to 1 vertical.

The only alternate to (3) above would be to raise the dam at least 3 feet to provide additional freeboard. I believe the emergency spillway would be more economical and safer.

In accordance with our phone discussion, I am transmitting a copy of this letter to Mr. Robinson to expedite his report to a Town Meeting on Saturday, April 27th.

Very truly yours,

John J. Mozzochi and Associates
Civil Engineers

JJM:hk

NOV 7 [illegible]

STATE WATER COMMISSION

#114 Thayer Building
Norwich, Connecticut

November 6, 1939

Mr. C. L. Robinson
First Selectman
Columbia, Connecticut

Dear Mr. Robinson:

After visiting Columbia Lake with you and Mr. Hutchins I find from the topographical map that the drainage area contributing to the Lake is about four square miles but the hills are not particularly steep and you have a large pond. You described to me the situation in the storm of September 1938 in which you had quite high waves on the Lake which washed the embankment somewhat so that you felt obliged to place sand bags along the upstream edge. There was no danger of the embankment being overtopped but whatever damage was done was caused by the wave action. The protection of the embankment slope by rip rap placed during the past year was well done and should protect the embankment from further erosion by the waves.

In regard to widening the spillway it is my recommendation that this be done as the width of the present spillway of 13 feet and with the abutment walls about 6 feet higher it does not come to our requirements. There was some indication on the ground that the spillway had been narrowed up, although I very much doubt this being done for it is hard to conceive why it should be. My recommendation is that you double up the width of the spillway carrying the stone abutments in a straight line, as you suggest, until it meets the steep slope of the existing channel. The new spillway, unless it comes on ledge, which seems improbable, should be paved as you suggest with stone pavers about 12" deep. I would also recommend, unless the material is extremely hard on the new section of the spillway, that you put in a 12" concrete cutoff wall on the new section of the spillway having this wall go down 3' or 4' into hard material.

I think the above work is nothing but what can be done by your own Town forces under your supervision.

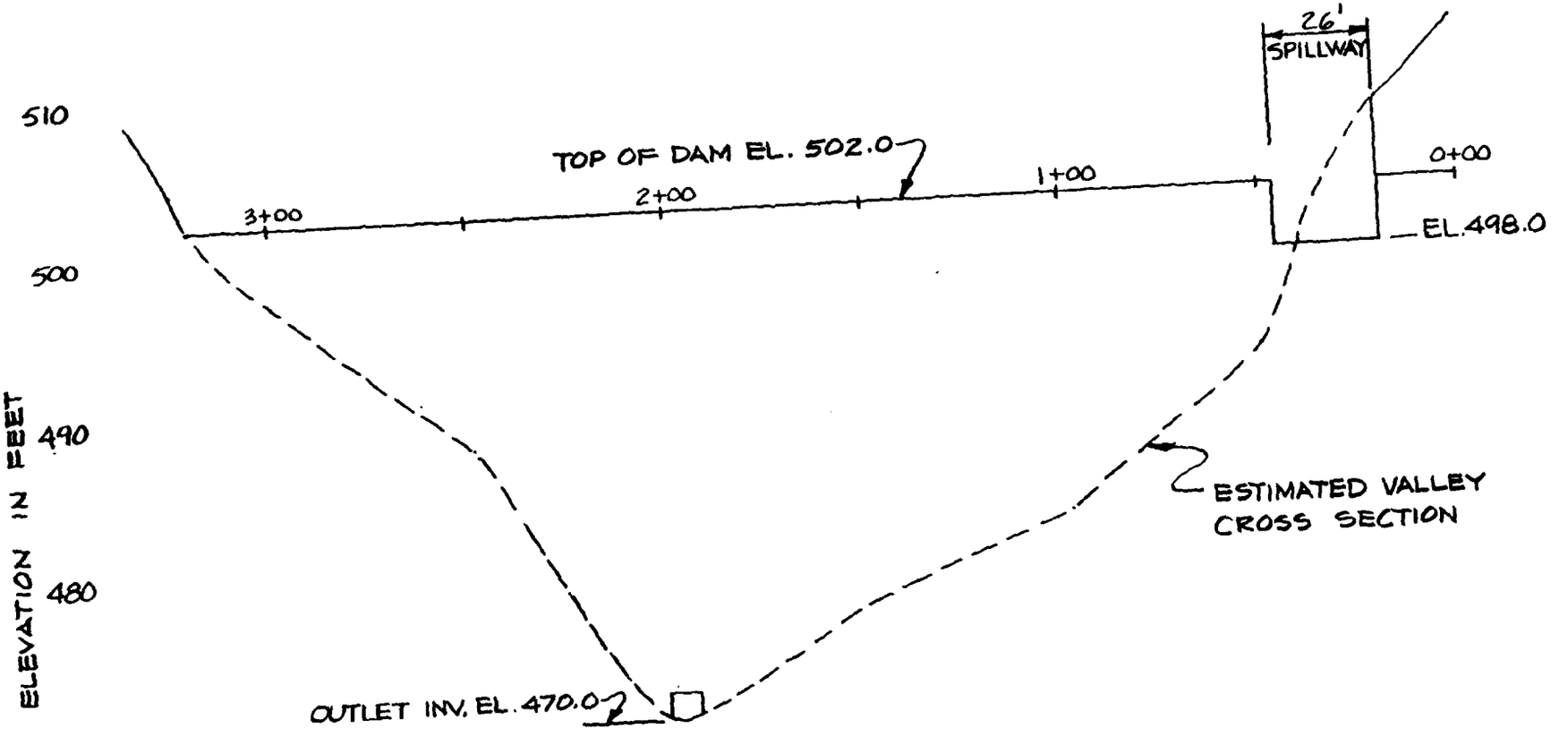
With kind regards to both you and Mr. Hutchins and remembering with pleasure how we three settled the affairs of the state, I remain

Very truly yours,

[signature]

Member, State Board of Supervision of

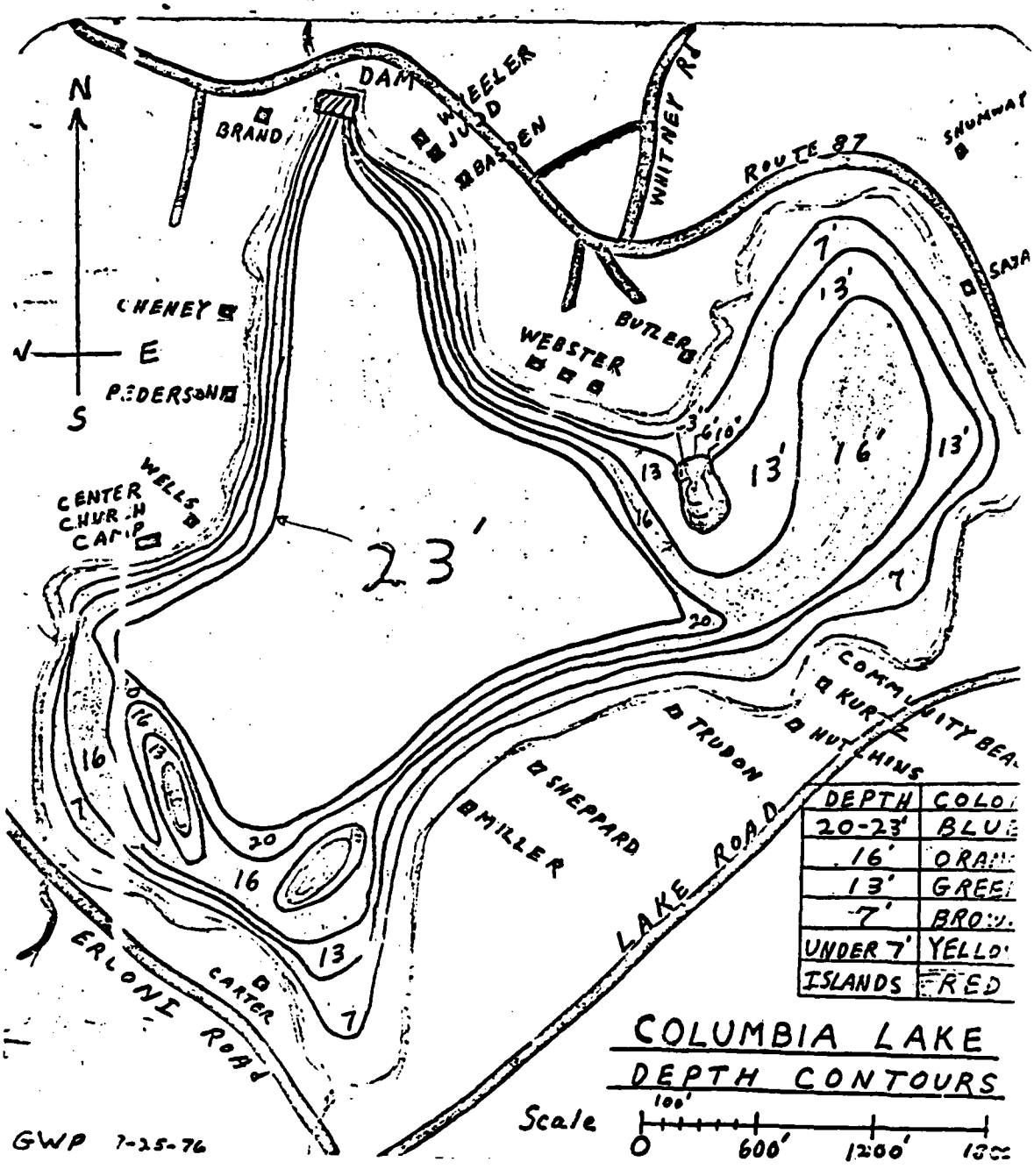
DEP/CT

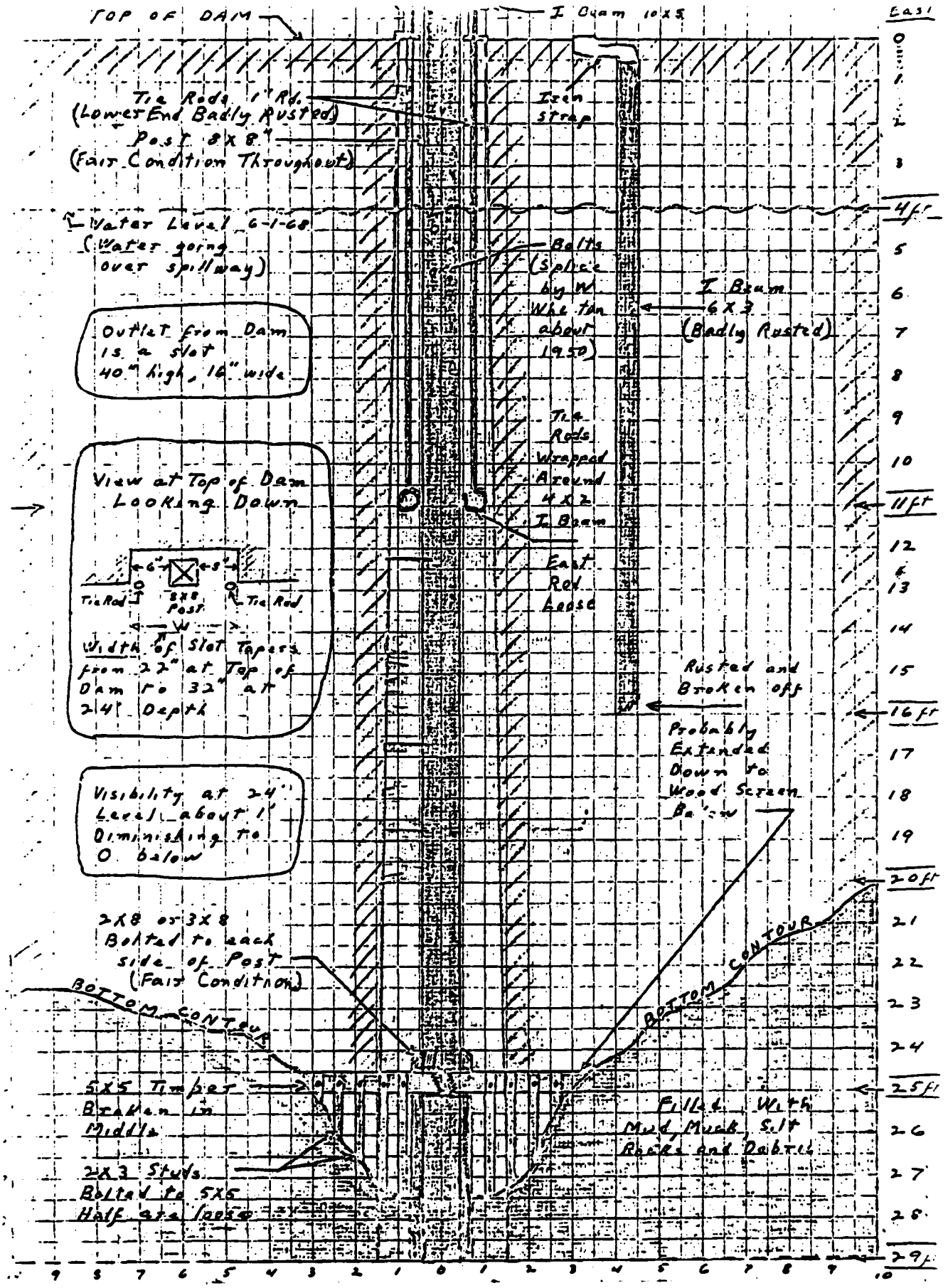


ELEVATION OF DOWNSTREAM FACE OF DAM

SCALE: HORZ. 1"=40'
VERT. 1"=10'

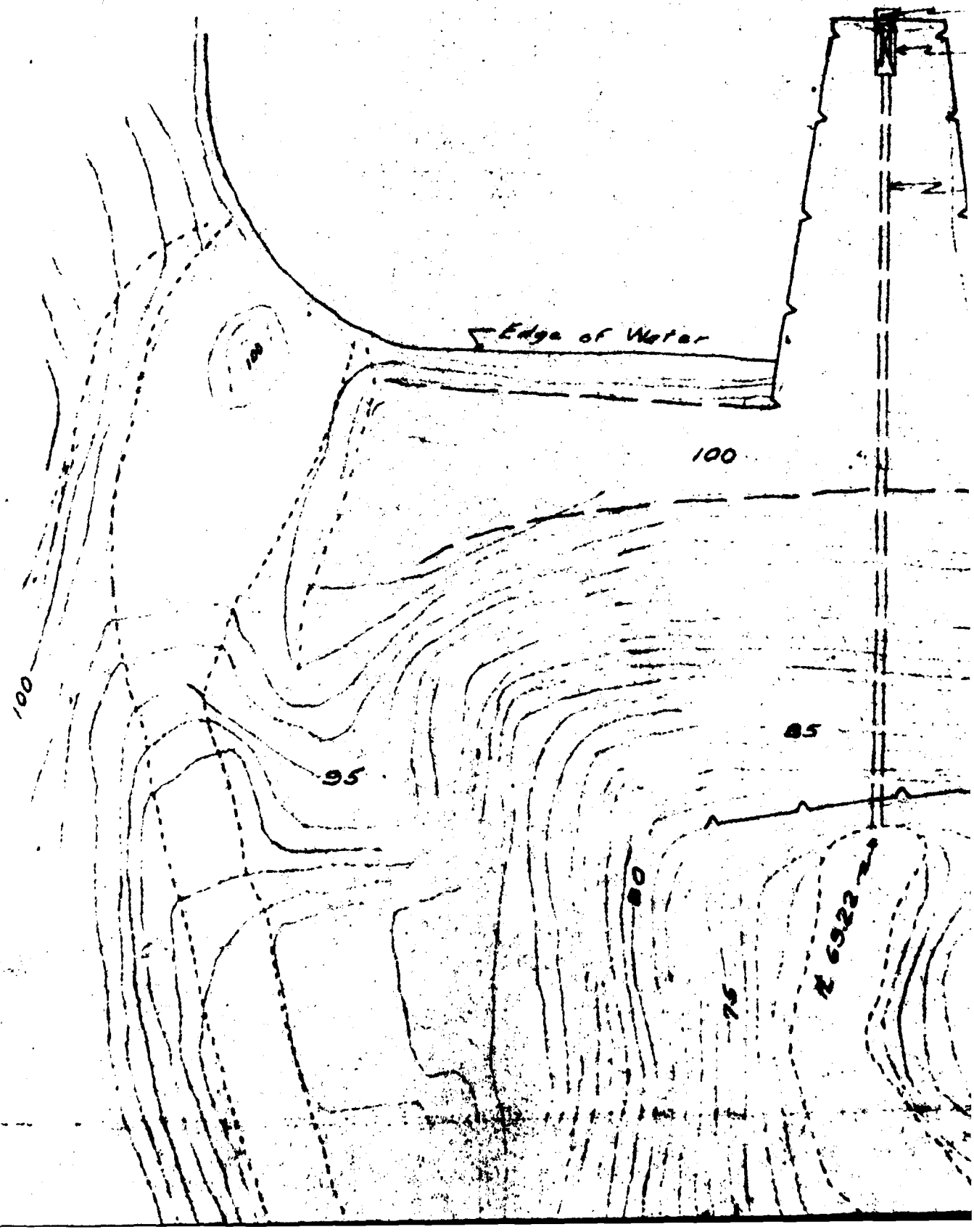
COLUMBIA LAKE DAM


N
E
S
DAM
BRAND
WHEELER
JUDD
BASDEN
WHITNEY RD
ROUTE 87
SNOWWAY
SAJA
CHENEY
PEDERSON
WEBSTER
BUTLER
WELLS
CENTER
CHURCH
CAMP
23'
7'
13'
16'
20
COMMUNITY BEA
KURTZ
HUTCHINS
TRUDON
SHEPPARD
MILLER
LAKE ROAD
ERLONI ROAD
CARTER
GWP 7-25-76
DEPTH
20-23'
16'
13'
7'
UNDER 7'
ISLANDS
COLOR
BLUE
ORANGE
GREEN
BROWN
YELLOW
RED
COLUMBIA LAKE
DEPTH CONTOURS
Scale
100'
600'
1200'

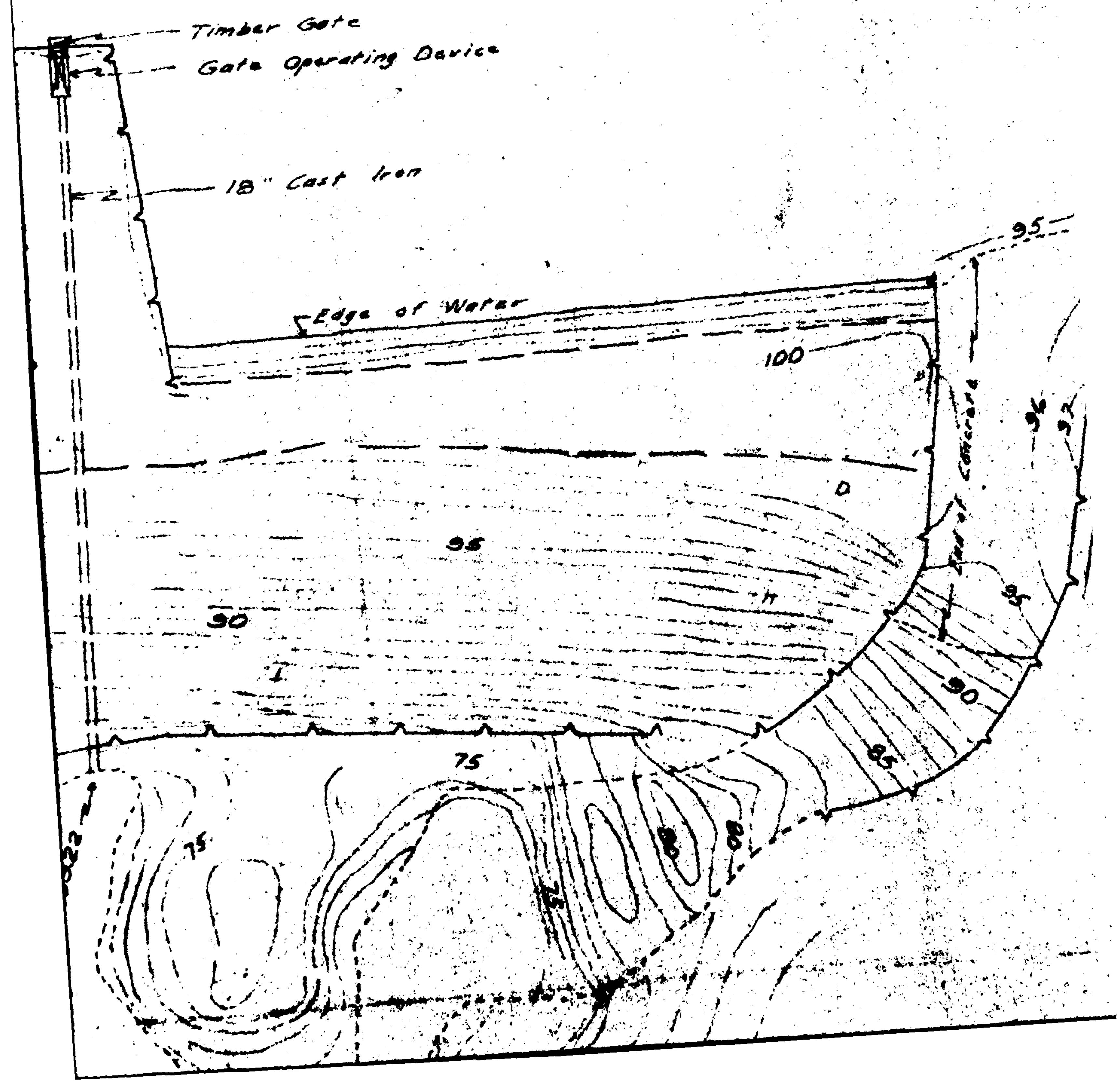


FRONT ELEVATION GATE STRUCTURE

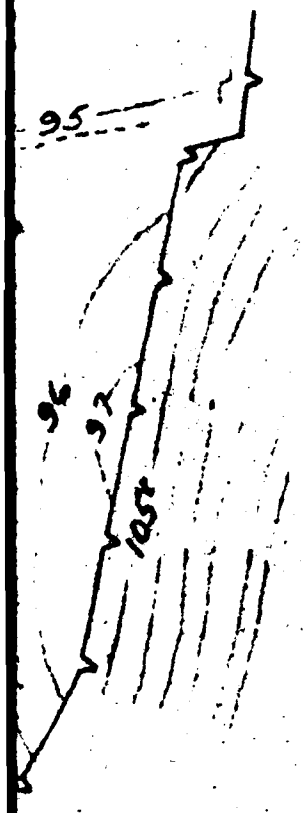
Scale 1/2" = 1'


Edge of Water
100
100
95
85
80
75
6922

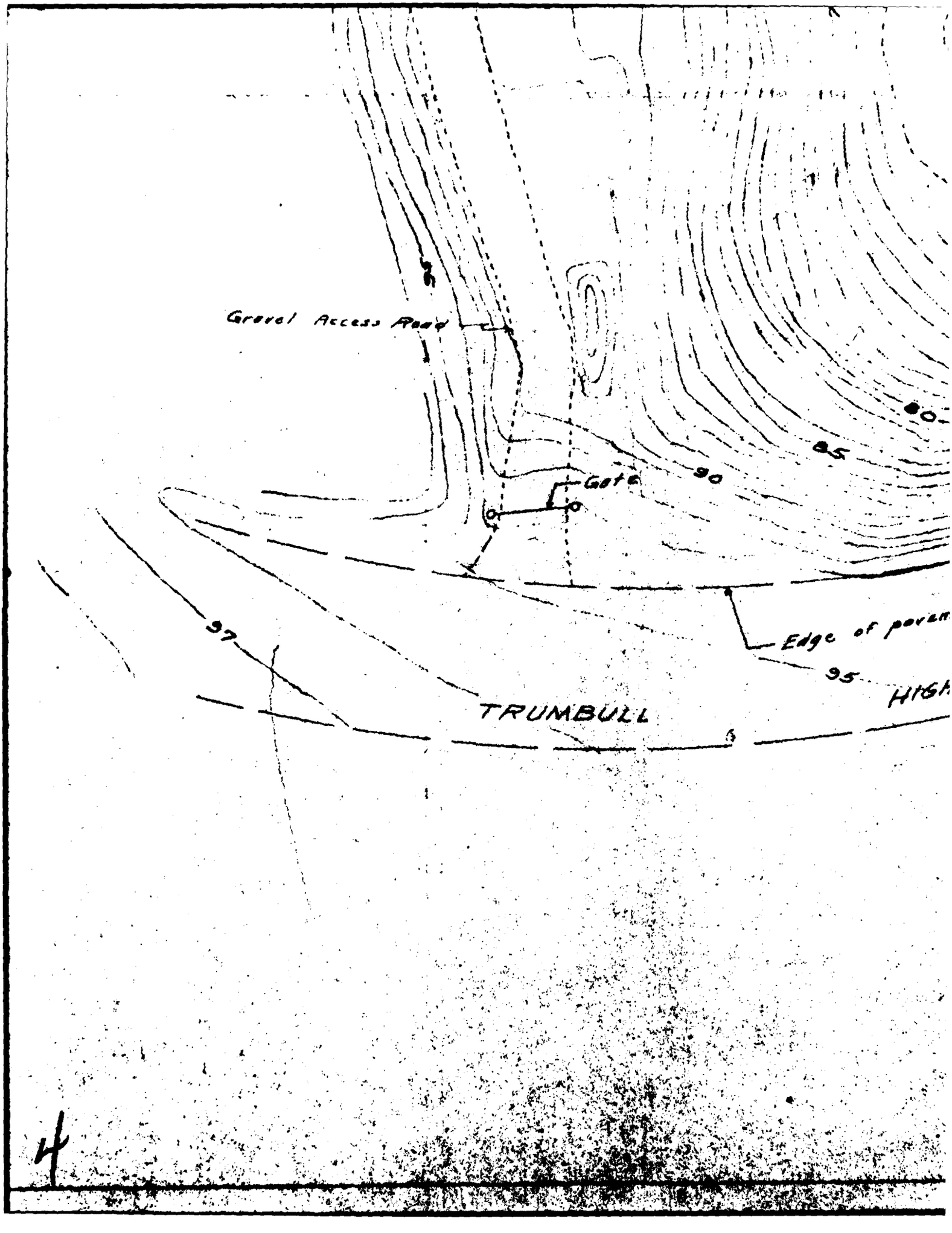
2

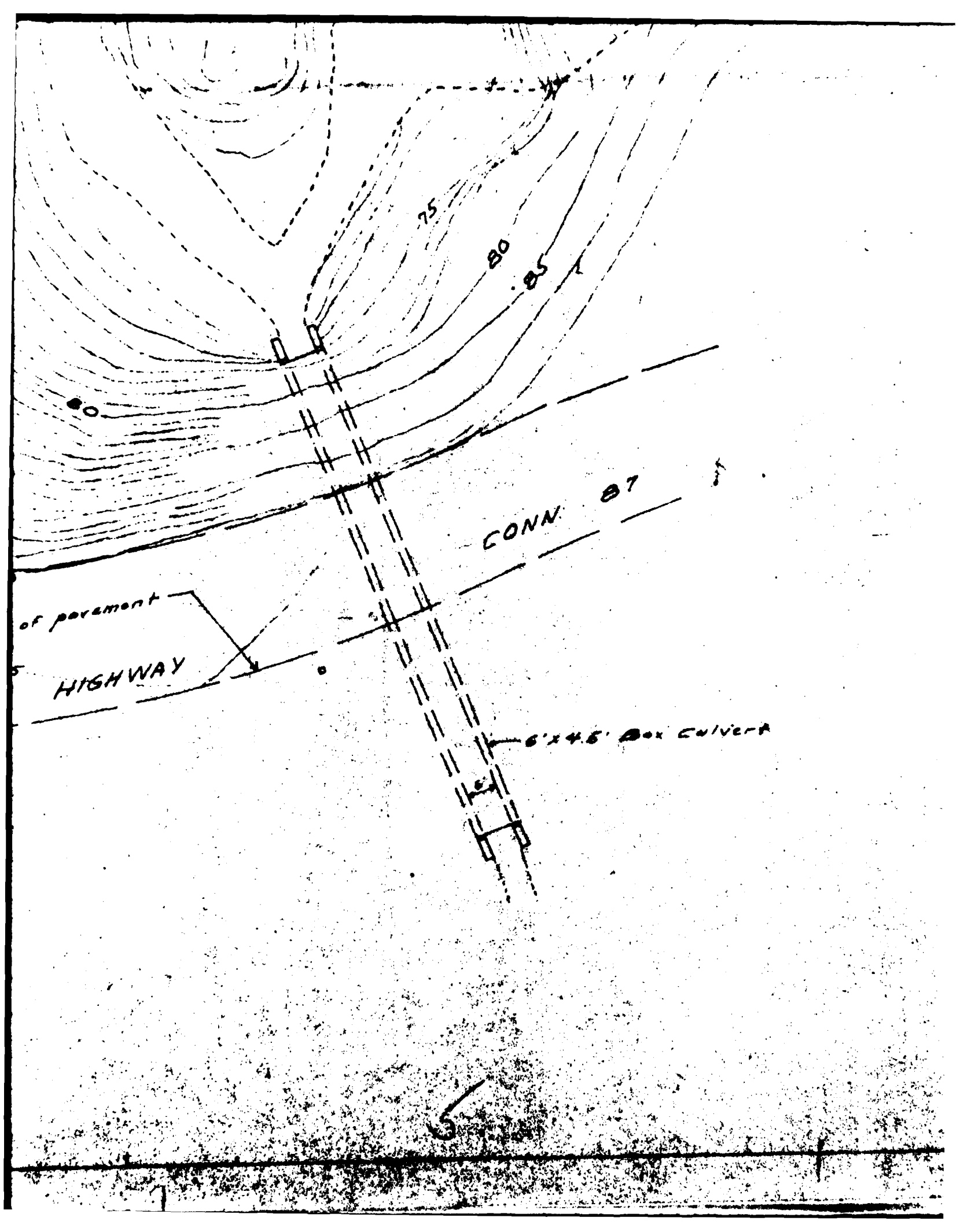


Timber Gate
Gate Operating Device
18" Cast Iron
Edge of Water
100
95
90
75
95
90
85
75


95
96
97
105


N


Gravel Access Road
Gate
90
85
97
Edge of pave
95
HIGH
TRUMBULL


75
80
85
CONN. 87
of pavement
HIGHWAY
6'x4.5' Box Culvert

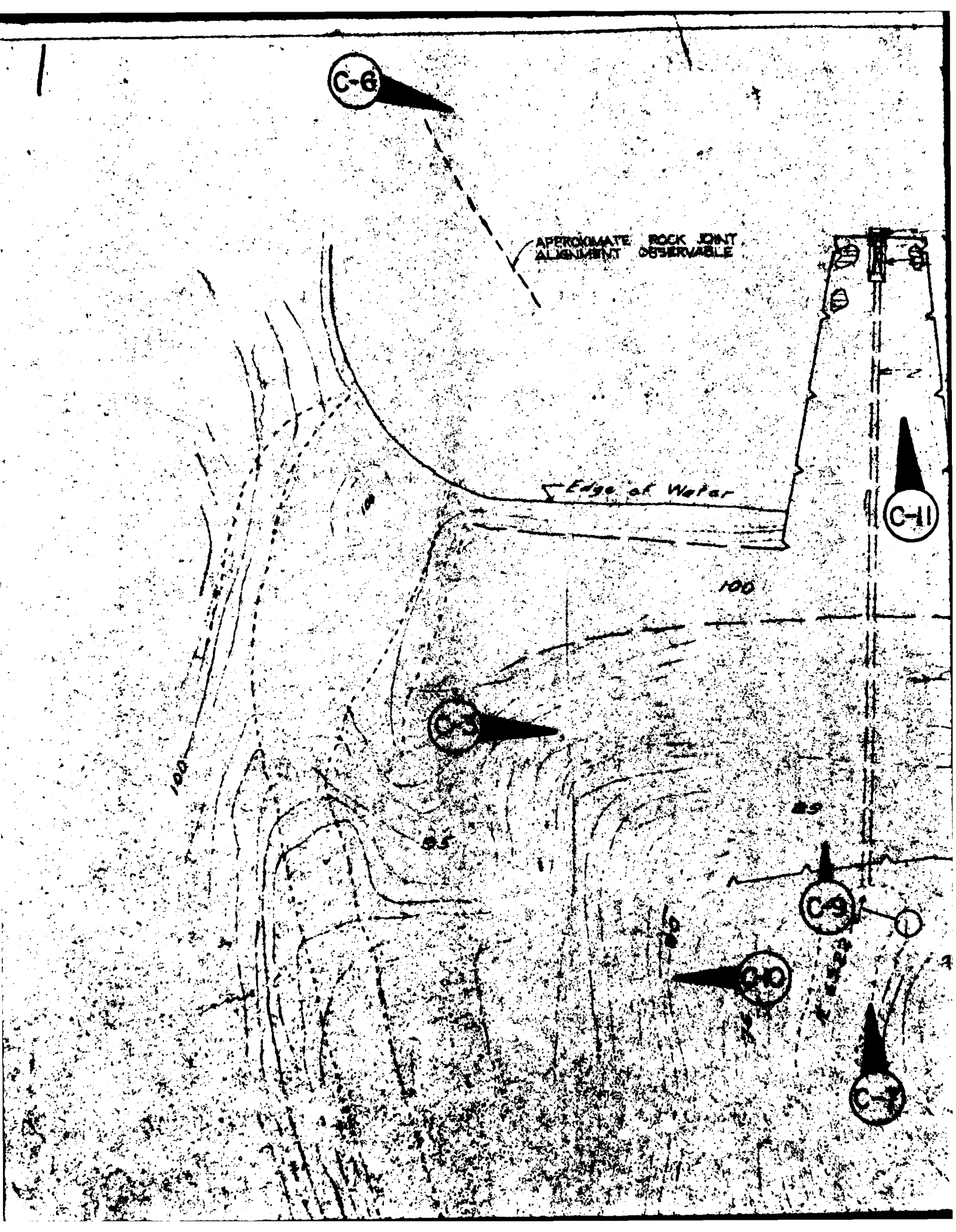
TOWN OF
COLUMBIA, CONNECTICUT

COLUMBIA LAKE DAM

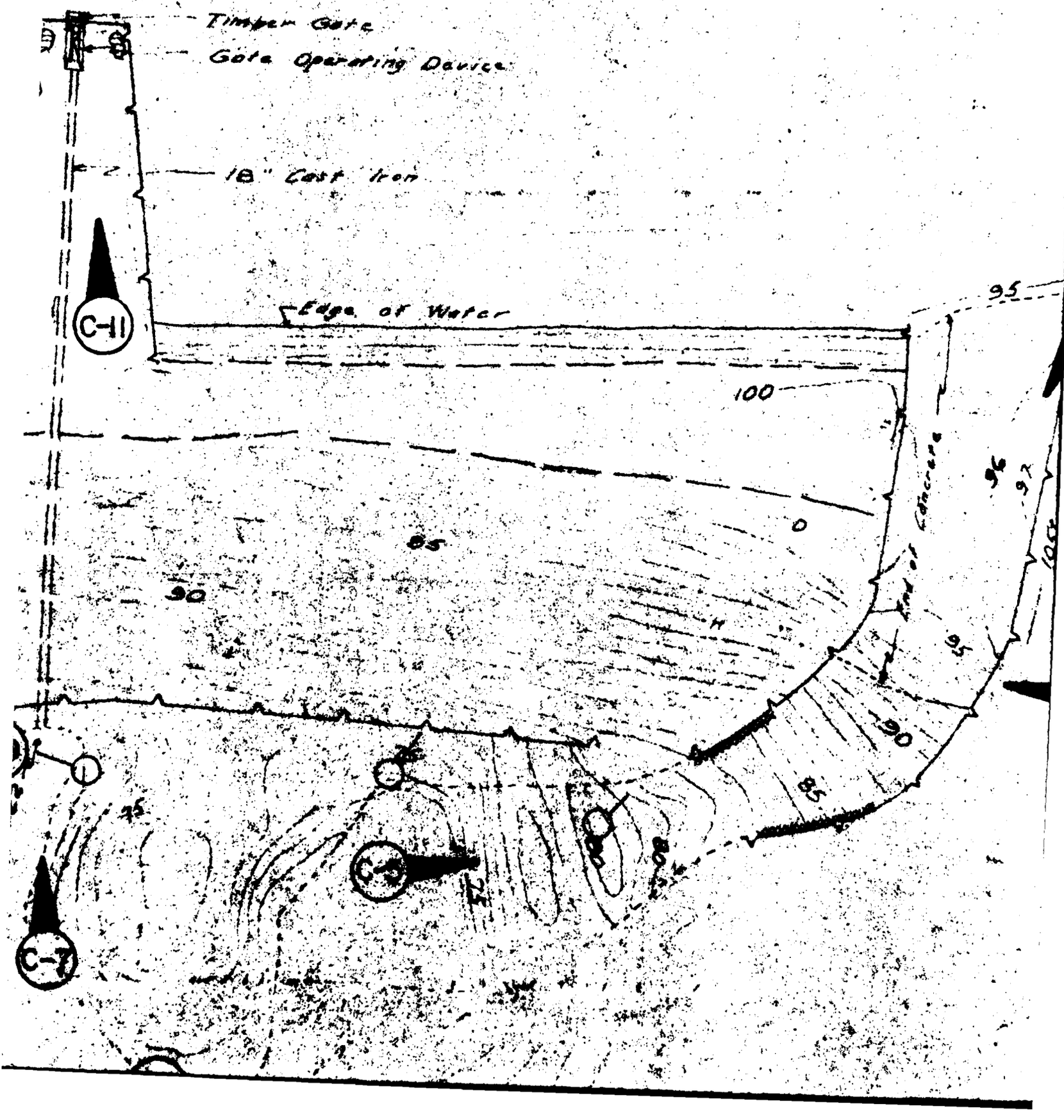
Scale: 1" = 80'
Date: June [illegible]
Prepared by: [illegible]

APPENDIX C

SELECTED PHOTOS

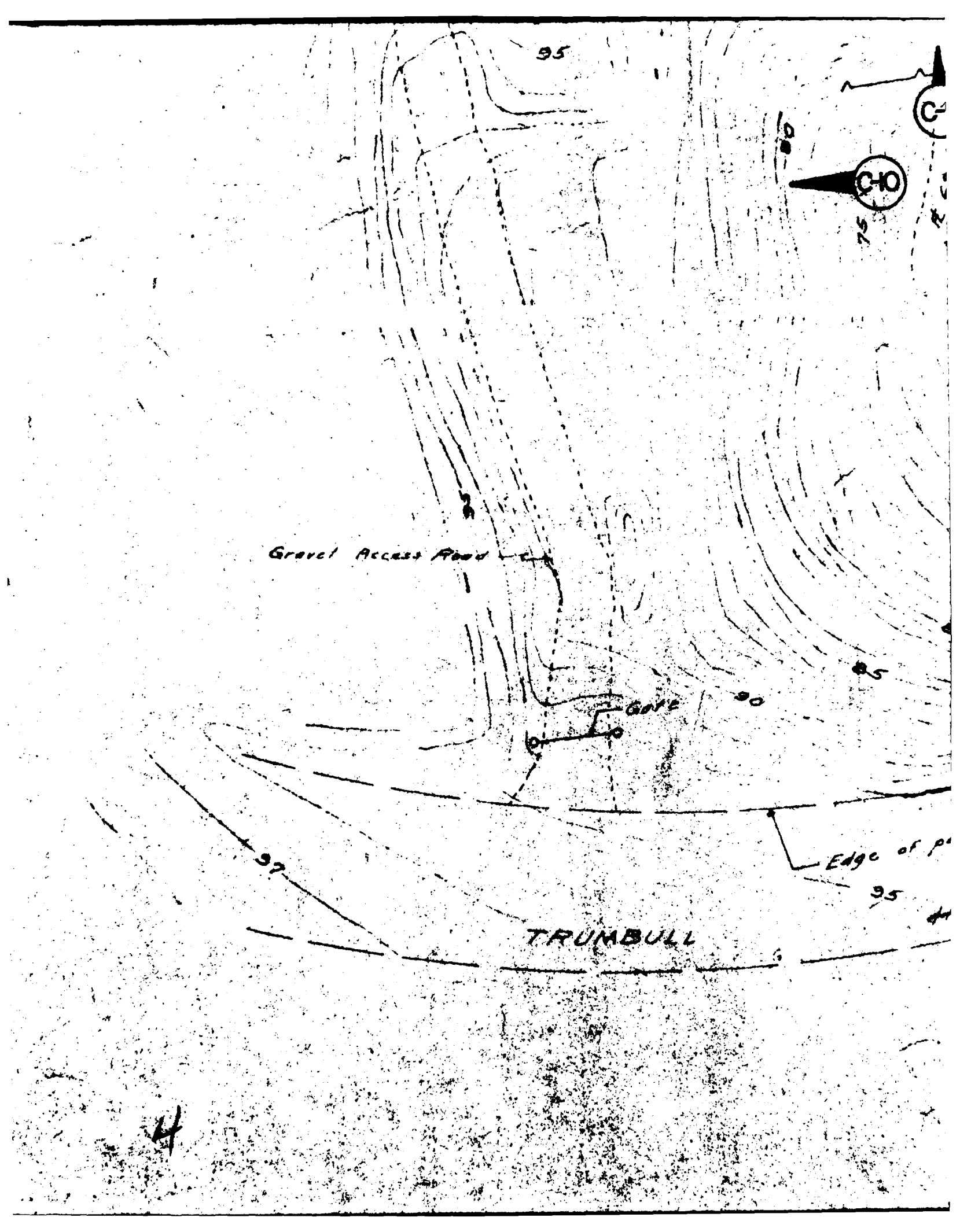

C-6
APPROXIMATE ROCK JOINT ALIGNMENT OBSERVABLE
Edge of Water
C-11
100
C-3
100
C-9
C-10
C-7

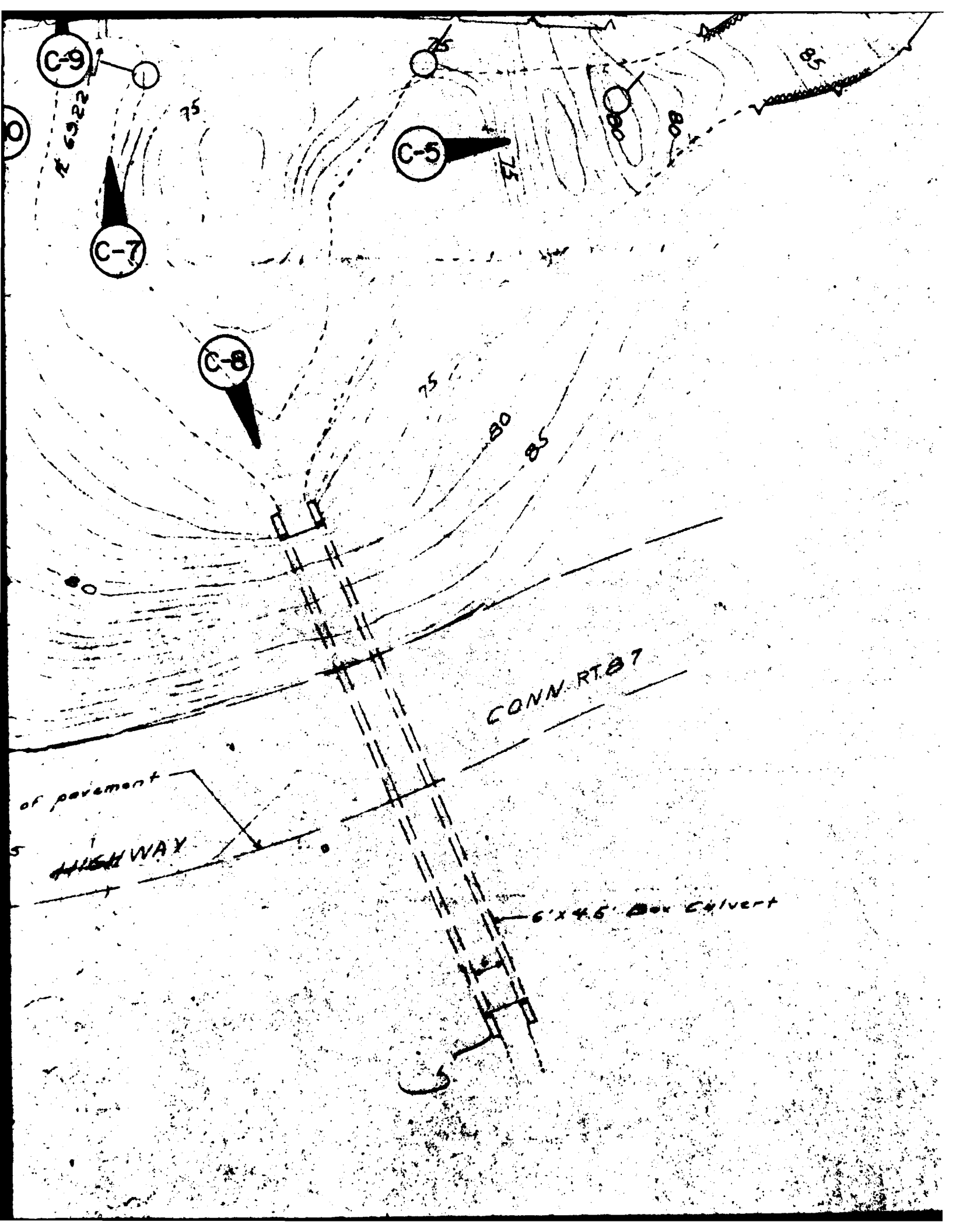
2


Timber Gate
Gate Operating Device
18" Cast Iron
C-11
Edge of Water
95
100
0
96
97
95
90
85
90
85
C-9
C-7

3

LEGEND


95
C-10
Gravel Access Road
Gate
90
85
Edge of
97
95
TRUMBULL
4


C-9
C-7
C-5
C-8
75
80
85
CONN. RT. 87
of pavement
HIGHWAY
6'x4.6' Box Culvert

LEGEND

DENOTES SEEPAGE ZONES

SURFACE EROSION HOLES

AREA OF DISLODGED MASONRY AND OBSTRUCTED SPILLWAY BED.

PHOTOGRAPH INDEX

TOWN OF
COLUMBIA, CONNECTICUT

COLUMBIA LAKE DAM

Scale: 1" = 20' June 1964
Datum: Assumed
Prepared by: T. A. Brindamour
Manchester, Conn.

C-2 LOOKING EAST AT DOWNSTREAM SLOPE DAM EMBANKMENT

C-3 LOOKING WEST ALONG CREST OF DAM EMBANKMENT

C-4 DOWNSTREAM SLOPE OF SPILLWAY

C-5 SEEPAGE EMANATING FROM DOWNSTREAM TOE OF SPILLWAY

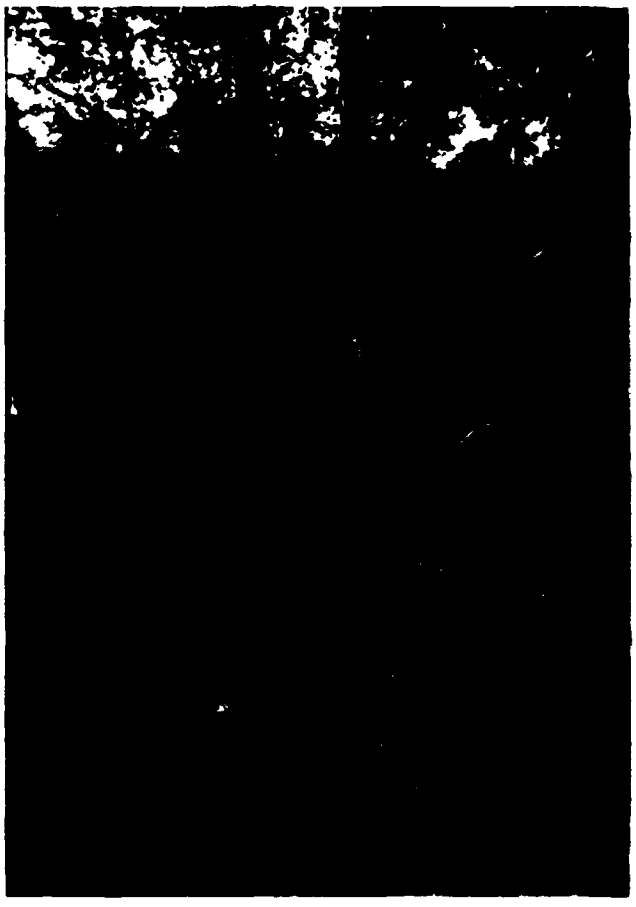
C-6 CONTROL GATE MECHANISM ON UPSTREAM PIER

C-7 STONE BOX CULVERT OUTLET AT EMBANKMENT TOE

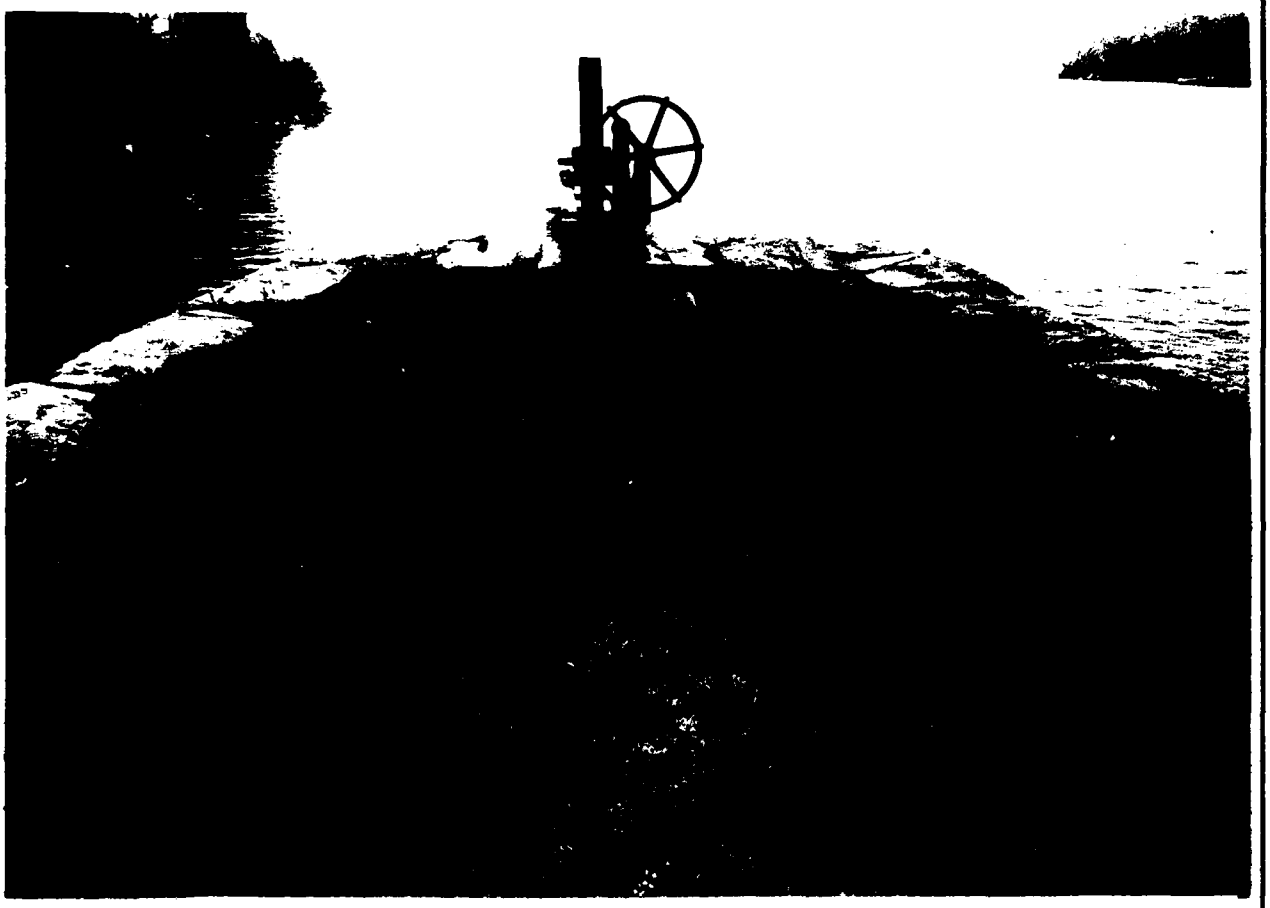
NOTE: RUST STAINING

C-8 LOOKING DOWNSTREAM AT ROUTE 87 CULVERT

C-9 STUMP AT TOE WALL ON DOWNSTREAM FACE OF EMBANKMENT



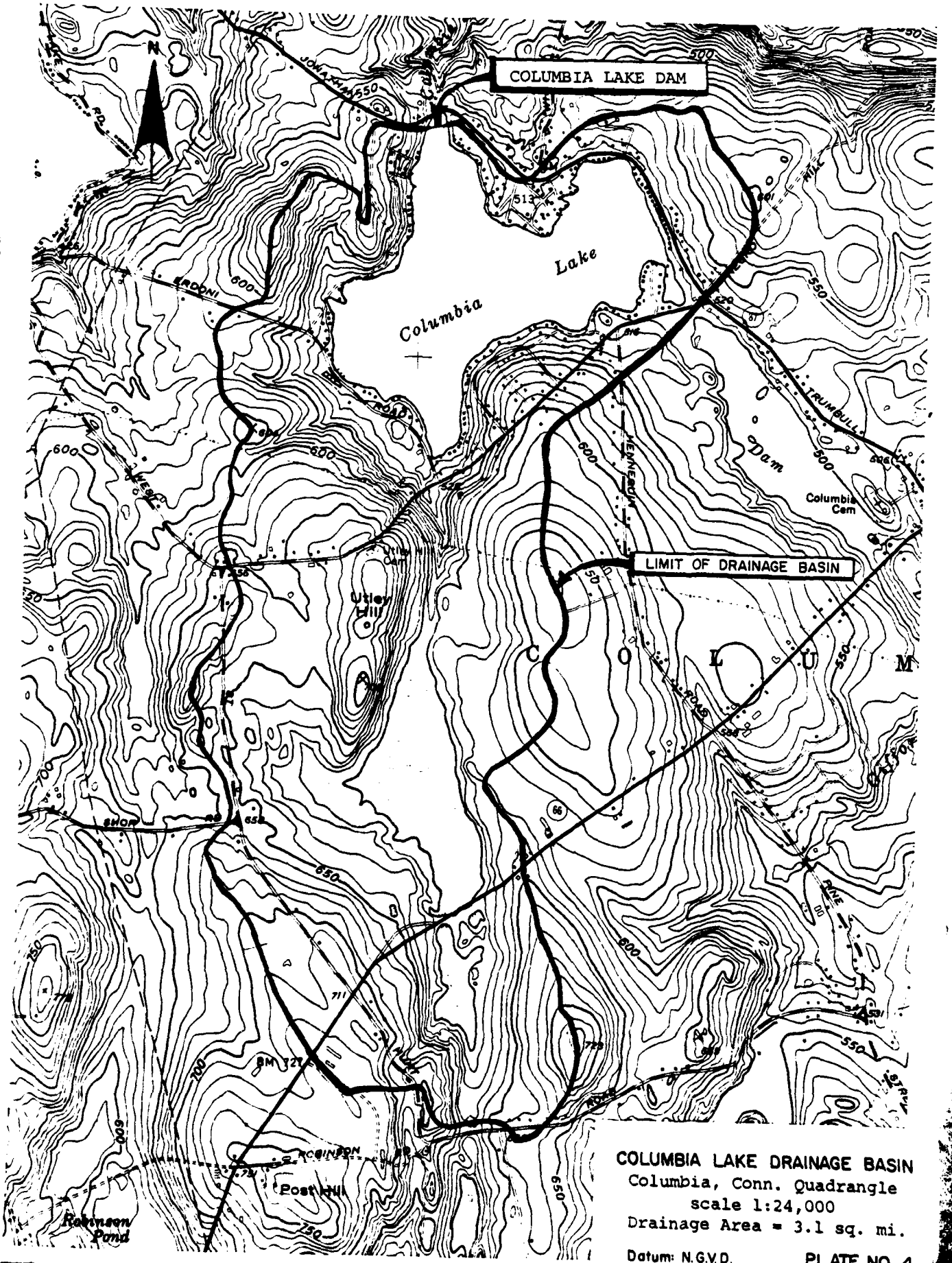
C - 10 SEEPAGE AREA AT DOWNSTREAM TOE



C-11 SINKHOLES AT GATE MECHANISM

APPENDIX D

HYDROLOGIC COMPUTATIONS



COLUMBIA LAKE DRAINAGE BASIN
Columbia, Conn. Quadrangle
scale 1:24,000
Drainage Area = 3.1 sq. mi.
Datum: N.G.V.D.

PLATE NO. 4

A. Size Classification

Height of Dam = 27.0 feet; Hence SMALL

at crest elevation reservoir storage = 3370 AC-ft., hence INTERMEDIATE

adopted size category INTERMEDIATE

B. Hazard Potential

DAM IS LOCATED IN AN AREA THAT IS NOW PREDOMINANTLY RURAL. FAILURE OF THE DAM IN THE NEAR FUTURE MAY NOT CAUSE DAMAGE TO LIFE OR HOMES BUT WILL INVOLVE APPRECIABLE ECONOMIC LOSS OF RECREATIONAL FACILITIES. THE FAILURE HAS A DISTINCT POTENTIAL OF WASHING OUT ROUTE 87 AND THE UTILITIES ADJACENT TO IT.

It is estimated from the rule of "thumb" failure hydrograph as follows:

Category	Loss of Life	Economic Loss
		Homes =
		Buildings = } NIL
		Farms =
		Miscellaneous = YES
SIGNIFICANT	NONE	Highways or roads = YES

C.

Hazard	Size	"Test Flood" or Spillway Design Flood
SIGNIFICANT	INTERMEDIATE	½ PMF TO PMF

Adopted
S.D.F. (test flood) = ½ PMF = 1000 CSM

Adopted value of test flood due to watershed characteristics = 1000 CSM

Estimating Maximum Probable Discharges - Inflow and Outflow Values Date of Inspection: 5/18/78

Name of Dam COLUMBIA LAKE DAM ; Location of Dam COLUMBIA LAKE BROOK Town HOP RIVER, CT.

Watershed Characterization ROLLING WITH FLAT SLOPES

Adopted "test" flood = HALF PMF = 1000 CSM = 3120 C.F.S.

D.A. = Drainage Area = 3.12 Square Miles = _____ Acres

S.A. = Surface Area of Reservoir = 0.422 Square Miles = 270 Acres

Shape and Type of Spillway = BROAD CRESTED, UNCONTROLLED, OVERFLOW

B = Width of Spillway = 26.0 feet; C = Coefficient of Discharge = (3.10 — Friction) = 3.00

Maximum Capacity of Spillway Without Overstopping = 624 C.F.S. = 20 % of test flood

Top of Dam Elevation = 502.00 ; Spillway Crest Elevation = 498.00

Length of Dam= 295 feet

Name of Dam	Test Flood Qp_1		Inflow Characteristics		Outflow Characteristics First Approximation			Outflow Characteristics Second Approximation			Outflow Characteristics Third Approximation		
	CSM	CFS	h_1 in feet	S_1 in inc.	Qp_2 CFS	h_2 in feet	S_2 in inc	S_3 in inc	h_3 in ft.	Qp_3 CFS	S_4 in inc.	h_4 in ft.	Qp_4 CFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14
COLUMBIA LAKE DAM	1000	3120	6.00	9.74	2851	5.85	9.50	6.49	4.0	624	7.99 = 8.00	4.93	1418

Qp = Discharge; h = surcharge height S = Storage in inches

"Rule of Thumb Guidance for Estimating
Downstream Dam Failure Hydrograph"

BASIC DATA

Name of dam COLUMBIA LAKE DAM Name of town HOP RIVER - Conn.

Drainage area = 3.12 sq.mi. Top of dam 502.0

Spillway type = UNCONTROLLED OVERFLOW Crest of spillway 498.0 NGVD

Surface area at crest elevation = 270 Acres

Reservoir bottom near dam = 471.0 NGVD

Assumed side slopes of embankments = 2:1

Depth of reservoir at dam site 27 ft = y_o = 27.0 ft.

Mid-height elevation of dam = 484.50 NGVD

Length of dam at crest = 260 feet

Length of dam at mid-height = 206 feet

40% of dam length at mid-height = W_b = 82 feet ft.

Stream height of dam = 28 feet

Hydraulic height of dam = 27 feet

Step 1:

Elevation M.S.L.	RESERVOIR Estimated Storage In AC-ft. = S	Remarks
498.00	3370	
499.00	3640	
500.00	3910	
501.00	4180	
502.00	4450	
503.00	4720	

Step 2:

$$Q_{pl} = \frac{8}{27} W_b \sqrt{g}\, y_o^{3/2}$$

$$= 1.68\, W_b\, y_o^{3/2} = 19327 \text{ C.F.S}$$

SHEET 0-2

Step 3:

Reach	Length in Feet	Stage	Discharge	Remarks
L_{1-2}	800	470	17980	
"	"	460	4770	
L_{2-3}	237.5	359	18608	
"	"	358	11158	
L_{3-4}	3000	288	17826	
"	"	285	8592	

Notes:

Step 4:

Reach Length 1-2

A) Q_{p1} = 19327 CFS

Stage = 471.87

Area = 915.70 sq. ft. = 0.021 AC

Length = L_{1-2} = 800 ft.

V_1 = _____ cu. ft. = 16.81 AC-ft.

S = 4720 AC-ft.

$\frac{V_1}{S}$ = 0.0036 less than 0.5; O.K.

B) Q_{p2} (Trial) = $Q_{p1}\left(1 - \frac{V_1}{S}\right)$ = 19300 CFS

C) Stage for Q_{p-2} = 471.80

Area = 910 sq. ft.

L_{1-2} = length = 800 ft.

V_2 = 16.8 AC-ft.

S = 4720 AC-ft.

$\frac{V_2}{S}$ = ____ less than 0.5; O.K.

D) $\frac{V_1 + V_2}{2} = V_{avg}$ = 16.81 AC-ft.

$Q_{p-2} = Q_{p-1}\left(1 - \frac{V}{S}avg\right)$

= 19300 CFS

Stage for Q_{p-2} = 471.80

Bed Elevation = 450.00

depth = 21.80 ft

Step 5:

Reach Length 2-3

Q_{p2} = 19300 CFS

Stage = 471.8

Area = 1280 sq. ft. = 0.0294 AC

Length = L_{2-3} = 2375 ft.

V_2 = _____ cu. ft. = 69.80 AC-ft.

S = 4720 AC-ft.

$\frac{V_2}{S}$ = 0.0147 less than 0.5; O.K.

Q_{p-3} (Trial) = $Q_{p-2}\left(1 - \frac{V_2}{S}\right)$ = 19000 CFS

Stage for Q_{p-3} = 358.90 ≈ 359

Area = 1280 sq. ft.

L_{2-3} = length = 2375 ft.

V_3 = 70 AC-ft.

S = 4720 AC-ft.

$\frac{V_3}{S}$ = .015 less than 0.5; O.K.

$\frac{V_2 + V_3}{2} = V_{avg}$ = 70 AC-ft.

$Q_{p-3} = Q_{p-2}\left(1 - \frac{V}{S}avg\right)$

= 19000 CFS

Stage for Q_{p-3} 359.0

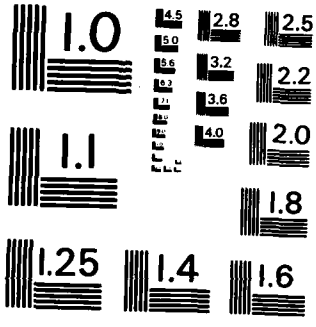
Bed Elevation = 355.0

depth = 4.0 ft

AD A144 768 NATIONAL PROGRAM FOR INSPECTION OF NON FEDERAL DAMS COLUMBIA LAKE DAM (CT (U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV SEP 78

2/2

UNCLASSIFIED F/G 13/13 NL



Step 4 (con't): Reach Length 3-4

Q_{p-3} = 19000 CFS

Stage = 288.4

Area = 1120 sq. ft. = ____ AC-ft.

Length = L_{3-4} = 3000 ft.

V_3 = ____ cu. ft. = 77.13 AC-ft.

S = 4720 AC-ft.

$\frac{V_3}{S}$ = 0.016 less than 0.5; O.K.

Q_{p-4} (Trial) = $Q_{p-3}(1 - \frac{V_3}{S})$ = 18734 CFS

Stage for Q_{p-4} = 288.3

Area = 1120

L_{3-4} = 3000 ft.

V_4 = 77 AC-ft.

S = 4720 AC-ft.

$\frac{V_4}{S}$ = 0.016 less than 0.5; O.K.

$\frac{V_3 + V_4}{2} = V_{avg}$ = 0.016 AC-ft.

$Q_{p-4} = Q_{p-3}(1 - \frac{V}{S}avg)$ ____

= 18700 CFS

Stage for Q_{p-4} = 288.3

Bed Elevation = 280.0

depth = 8.3'

(May overflow Route 6)

Step 5 (con't): Reach Length 4-5

Q_{p-4} = ____ CFS

Stage = ____

Area = ____ sq. ft. = ____ AC-ft.

Length = L_{4-5} = ____ ft.

V_4 = ____ cu. ft. = ____ AC-ft.

S = ____ AC-ft.

$\frac{V_4}{S}$ = ____ less than 0.5; O.K.

Q_{p-5} (Trial) = $Q_{p-4}(1 - \frac{V_4}{S})$ = ____ CFS

Stage for Q_{p-5} = ____

Area = ____

L_{4-5} = ____ ft.

V_5 = ____ AC-ft.

S = ____ AC-ft.

$\frac{V_5}{S}$ = ____ less than 0.5; O.K.

$\frac{V_4 + V_5}{2} = V_{avg}$ = ____ AC-ft.

$Q_{p-5} = Q_{p-4}(1 - \frac{V}{S}avg)$ ____

= ____ CFS

Stage for Q_{p-5} = ____

Step 3:

Reach No.	Distance in Feet	Mean Slope	Adopted "n"	Stage = 470 A	P	R	V	Q	Stage = 460 A	P	R	V	Q	Stage =
1-2	L_{1-2} = 800	0.025	0.05	800	76.6	10.44	22.5	17980	300	48.28	6.21	15.90	4770	
				Stage = 359					Stage = 358					
2-3	L_{2-3} = 2375	0.0400	0.05	1280	341	3.753	14.53	18608	945	330	2.86	11.80	11158	
				Stage = 288					Stage = 285					
3-4	L_{3-4} = 3000	0.025	0.05	1120	180	6.22	15.91	17826	625	150	5.0	13.74	8592	
4-5	L_{4-5} =													
5-6	L_{5-6} =													

Notes: 1. Reach No 1 is at the Dam

2. "n" value is Weighted Manning's roughness Coefficient

Storage Elevation Estimation Procedure

Elevation	Depth in Feet	Area Acres	Storage Capacity AC-ft.	
			Increment	Cumulation
498.00	— Varies	270.00	—	3370
499.00	—	"	270	3640
500.00	—	"	270	3910
501.00	—	"	270	4180
502.00	—	"	270	4450
503.00	—	"	270	4720

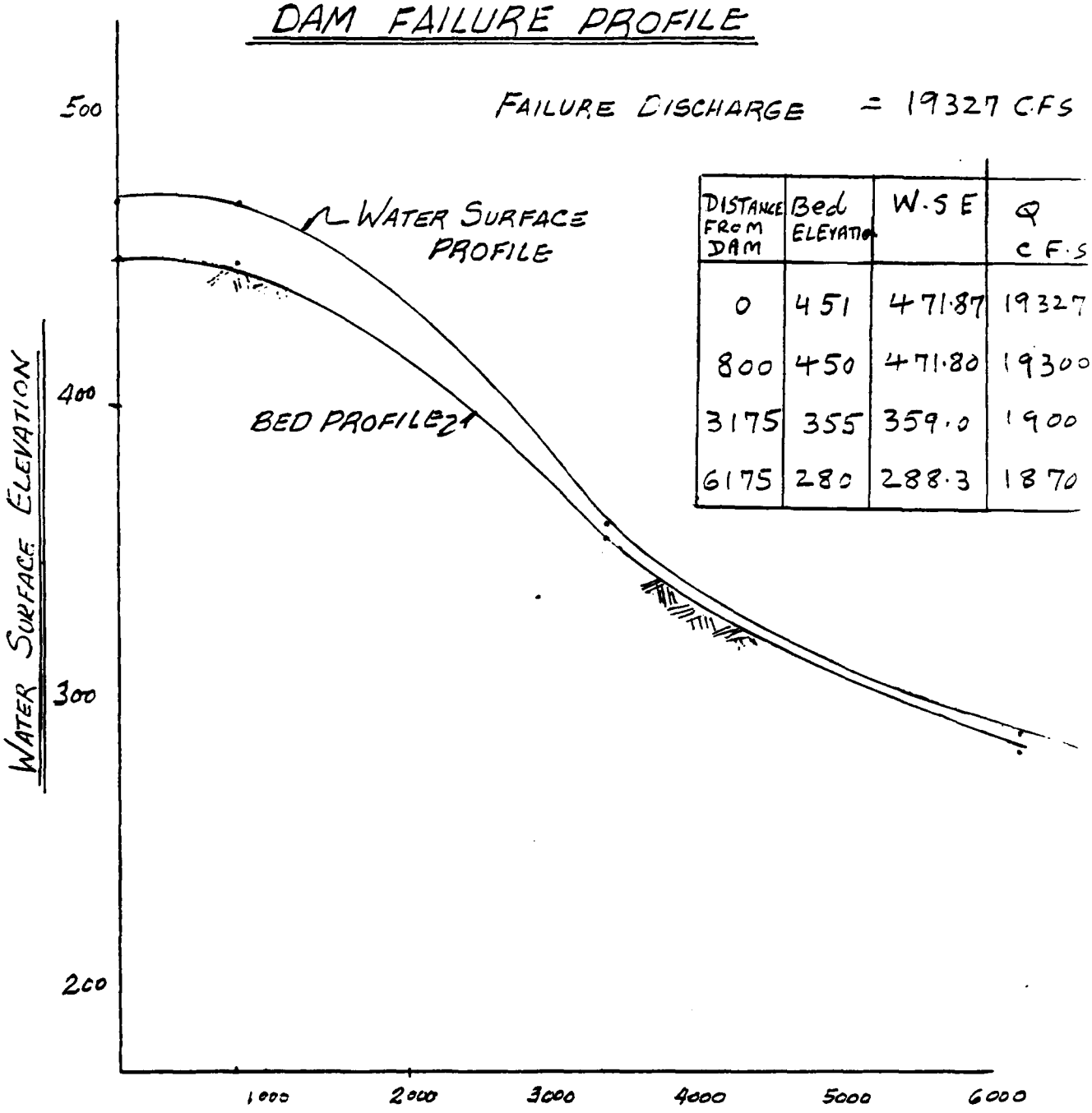
Notes:

PROJECT COLUMBIA LAKE DAM ACC. NO. 3155.202
SUBJECT DAM FAILURE PROFILE SHEET NO. D-7 OF
DATE 19
COMP. CHECK CONT. NO.

DAM FAILURE PROFILE

FAILURE DISCHARGE = 19327 CFS

DISTANCE FROM DAM	Bed ELEVATION	W.S E	Q C.F.S
0	451	471.87	19327
800	450	471.80	19300
3175	355	359.0	1900
6175	280	288.3	1870



Overtopping Potential

Spillway crest elevation = 498.00 M.S.L.

Top of dam elevation = 502.00 M.S.L.

Maximum discharge capacity of Spillway without overtopping = 624 C.F.S.

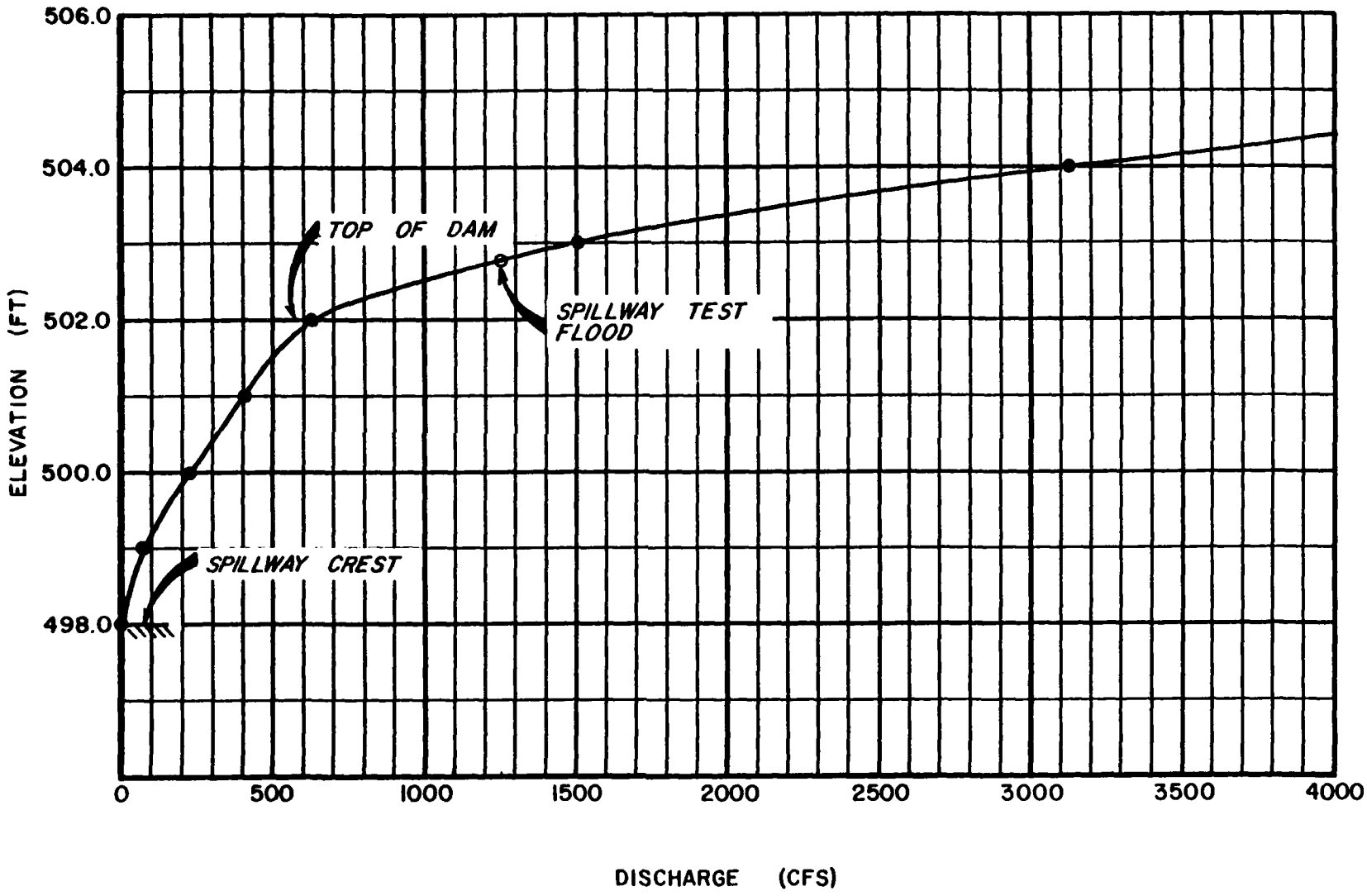
"Test flood" outflow discharge = 1418 C.F.S.

% of "Test flood" carried by Spillway without overtopping = 44 % 1

"Test flood" outflow discharge which flows over the dam = 794 C.F.S.

= 56.0 % of "Test flood" 2

1 + 2 = 100%



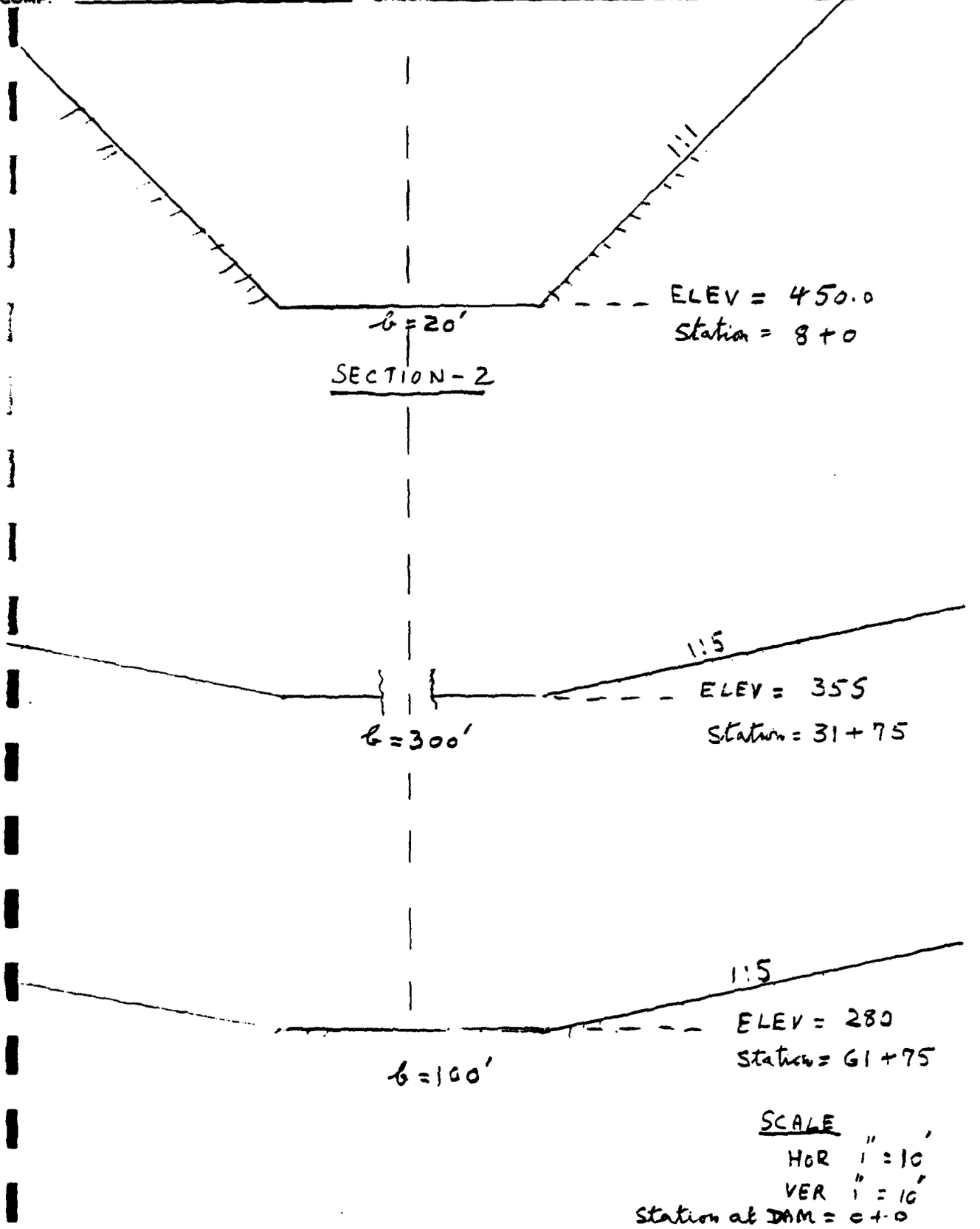
SPILLWAY RATING CURVE
COLUMBIA LAKE DAM

PROJECT COLUMBIA LAKE DAM — ACC. NO. 3155.202

SUBJECT DAM FAILURE PROFILE X-SECTIONS — SHEET NO. D-10 OF ____

DATE May 19 78

COMP. ____ CHECK ____ CONT. NO. ____



SCALE

HOR 1" = 10'

VER 1" = 10'

Station at DAM = 0+0

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR DIST	STATE	COUNTY	CONGR DIST	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY	MO	YR
CT	520	NED	CT	013	02				COLUMBIA LAKE DAM	4143.3	7220.0	15	AUG	78

POPULAR NAME	NAME OF IMPOUNDMENT
	COLUMBIA LAKE

REGION/BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI.)	POPULATION
01 07	COLUMBIA LAKE BROOK	HOP RIVER	1	1000

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)	DIST	DAM	FED H	PRV/FED	SCS A	VER/DATE
HEPG	1965	R	28	27	4450	3570	NED	N	N	N	N	07AUG78

REMARKS

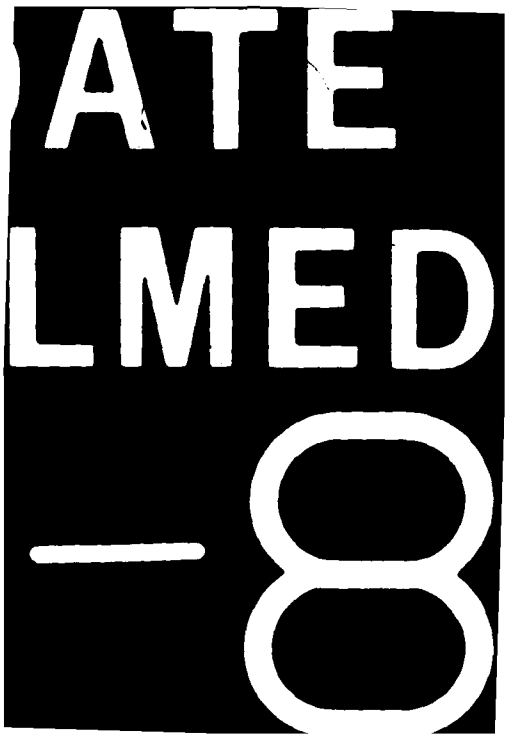
D/S HAS	SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (FT.)	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
2	295	U	26	624												

OWNER	ENGINEERING BY	CONSTRUCTION BY
TOWN OF COLUMBIA	UNKNOWN	UNKNOWN

REGULATORY AGENCY			
DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE

INSPECTION BY	INSPECTION DATE DAY	MO	YR	AUTHORITY FOR INSPECTION
C-E MAGUIRE INC.	18	MAY	78	PL 92-367

REMARKS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